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FOREST RESOURCES OF THE SOUTHERN COASTAL PLAIN OF NORTH CAROLINA

by

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A FOREST SURVEY PROGRESS REPORT

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PREFACE

Through the McSweeny-McNary Act of 1928, Congress authorized the Secretary of Agriculture to conduct a comprehensive survey of the forest resources of the United States. The Forest Survey was organized by the Forest Service to carry out the provisions of the Act, and each of the 12 Regional Experiment Stations was made responsible for the work in its territory. In the Middle Atlantic States the Forest Survey is an activity of the Appalachian Forest Experiment Station, Asheville, North Carolina.

The work of the Survey is divided into 5 major phases:

1. Inventory. Determination of the extent, location, and condition of forest lands, and the quantity, species, and quality of the timber on these lands.

2. Growth. Determination of the current rate of timber growth.

3. Drain. Determination of the amount of industrial and domestic wood use, and the total loss resulting from fire, insects, disease, suppression, and other causes.

4. Requirements. Determination of the current and probable future requirements for forest products by all classes of consumers.

5. Policies and plans. Analysis of the relation of these findings to one another and to other economic factors as a basis for public and private policies and plans of forest land use and management.

This progress report presents preliminary information on the first three of these phases for the Southern Coastal Plain of North Carolina, one of the 4 units into which the state was divided. Similar releases will be published for the other units of the state which are the Northern Coastal Plain, the Piedmont Region, and the Mountain Region.

Information on the physical forest resources was obtained by a field survey made in the spring of 1937. A total of 10,248 sample plots were established at intervals of one-eighth of a mile on compass lines 10 miles apart, extending across the unit in a northeast direction. The statistical sample obtained from these plot records forms the basis for all area and volume estimates in this report, except where other sources are directly credited. Owing to the method of sampling data, small tabular items have the greater probability of error and should be considered as indicating relative magnitude rather than actual values.

Data on consumption of forest products for industrial and domestic purposes were obtained by canvassing all primary manufacturing plants and a number of representative domestic consumers.

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C O N T E N T S

FOREST RESOURCES OF THE SOUTHERN COASTAL PLAIN OF NORTH CAROLINA

DESCRIPTION OF THE UNIT

North Carolina Forest Survey Unit 1 is composed of a group of 21 counties situated in the southeastern portion of the State (fig. 1). It lies in the drainage basins of the Neuse, Cape Fear, and Pee Dee Rivers, and occupies about one-half of the State's coastal plain area, extending inland about 125 miles. This unit, of 8,333,500 acres, covers 27 percent of the total area of the State and includes 30 percent of the forest land.

It is primarily a farm and forest region, with about 55 percent of the land in farm ownership, and with forest land, including that on farms, occupying 67 percent of the unit area. Wilmington, near the mouth of the Cape Fear River, is the largest city (1930 pop. 32,000), and Goldsboro, Fayetteville, and Kinston each have more than 10,000 inhabitants. According to the 1935 Census of Manufactures there were only 22,000 people employed in all manufacturing industries in the unit, and they received only 6 percent of all the wages paid by manufacturers in the State during that year.

Physical Conditions

The Coastal Plain comprises two rather distinct topographic areas; the Tidewater and the Western Coastal Plain. The Tidewater area extends inland 30 to 50 miles from the Atlantic Ocean. It is a low, level, poorly drained region, generally less than 50 feet above sea-level. Several hundred thousand acres lie in almost impenetrable swamps. The Western Coastal Plain, situated between the Tidewater country and the Piedmont Plateau to the west, is level or gently rolling. It rises gradually to an elevation of 500 feet above sea-level along the "fall line" where the Coastal Plain meets the Piedmont Plateau. The Sandhills, a distinctive part of the Western Coastal Plain, extend from Sanford, in Lee County, southwestward along the western boundary of the unit to South Carolina. They occupy a belt about 30 miles wide and have a gently rolling surface which is 400 to 500 feet above sea level.

The better-drained soils of the Tidewater area are sands and sandy loams of the Portsmouth and Norfolk series that are well adapted to both agricultural and forest crop production. The muck soils of the swamps are not always suitable for cultivation even when drained artificially. With the exception of the Sandhills the soils in the Western Coastal Plain are silt and sandy loams, represented largely by the Norfolk series. These soils are easily worked but must be heavily fertilized to produce large yields of agricultural crops. The Sandhill soils are chiefly coarse sand, sand, and sandy loam, nearly all of the Norfolk series. They have little natural fertility but when well fertilized are adapted to the production of peaches and truck crops. Forest stands grow well on all except the muck soils of the Tidewater area and the most sterile sands of the Sandhills.

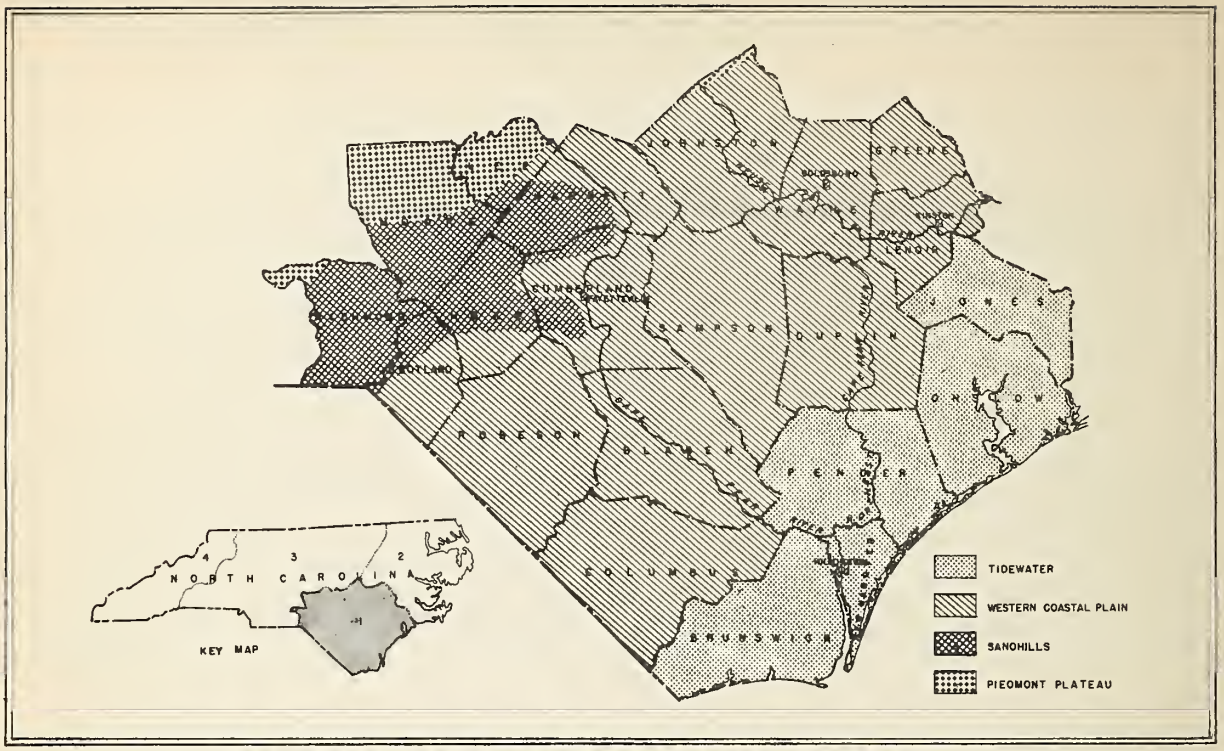

FIGURE 1.- PHYSICAL DIVISIONS OF NORTH CAROLINA UNIT I

Economic Conditions

Most of the Scotch and English people who settled in this area more than 200 years ago came from Virginia and South Carolina. The increase in population was slow until around 1890. At that time the agricultural population began to increase rapidly since turpentining and subsequent lumbering had cleared large areas of land adaptable to cultivation. According to the Bureau of the Census, the population of 392,000 in 1900 increased to 664,000 by 1930. During this latter year 60 percent of the people lived on farms, 24 percent lived in small towns or rural communities, and 16 percent lived in towns of more than 2,500 inhabitants. In the Tidewater counties, where swamps and forest land are extensive, the population is less than 35 per square mile, in contrast to the Western Coastal Plain counties where more industrialization and expanded agricultural activity caused an increase to about 60 people per square mile.

In 1935 about 207,000 persons were employed; 80 percent in agriculture, 10 percent in manufacturing, 5 percent in retail trade, 1 percent in wholesaling, and 4 percent in miscellaneous industries.1/ Of the 22,000 engaged in manufacturing, 14,000 were employed in the textile industry and 5,000 in the forest products industries. The enumeration of employees in

1/United States Department of Commerce, Census of Agriculture, 1935, and Consumer's Market Data Handbook, 1935.

the textile industry is fairly accurate, because of large, fixed plants, but such is not the case in the forest products industries where small plants and part time woods work are common. A more detailed discussion of forest employment will be given later in this report.

According to the Census of Agriculture the 4.6 million acres in farms produced crops valued at 77 million dollars in 1934. The chief source of farm income was the tobacco crop, valued at 41 million dollars in 1934. Only 39 percent of the farm acreage was cropland, however, as 54 percent was woodland and 7 percent was in other uses. Corn, cotton, hay, and tobacco occupied 92 percent of all the cropland harvested, but forest land on farms exceeded the combined area in these crops by 1 million acres.

Manufacturing in the unit is concentrated upon the production of textiles and forest products. Although important in certain localities, manufacturing is a minor part of such activity in the state, accounting for only 9 percent of the employees, 6 percent of the payroll, and 6 percent of the value added by manufacture.2/ The textile industry is represented by nearly 50 mills, located in or adjacent to the sandhill region. The plants manufacturing forest products are much smaller than the textile mills. About 500 primary plants, such as sawmills, and more than 30 secondary plants, such as furniture factories, are distributed throughout the unit. These two major industries employed at least 90 percent of those engaged in manufacturing in 1935.

The Atlantic Coast Line and the Seaboard Air Line Railway systems own and operate practically all of the railroads. From Wilmington the railroads extend in a fan-like pattern but they are so widely separated that large areas in the Tidewater counties are more than 10 miles from rail facilities, in contrast to the Western Coastal Plain counties where main-line and inter-connecting roads are more closely distributed. The highway system is generally well developed. Brunswick, Columbus, Duplin, and Pender counties have few paved tributary highways because much of their area is in extensive swamps containing few inhabitants. The Intracoastal Waterway skirts the unit behind the "banks" along the ocean and provides a channel at least 8 feet deep for water-borne traffic. The Cape Fear River is adapted to ocean going vessels up to Wilmington, and at least an 8-foot depth is maintained as far upstream as Fayetteville, over 100 miles from the sea.

In 1937 the assessed value of all real and personal property in this unit was 387 million dollars, or 16 percent of the assessed value of the state.3/ In Bladen, Cumberland, Harnett, and Onslow counties the assessed value of forest land and timber was 12 percent of the assessed value of all

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2/United States Department of Commerce, Census of Business, 1935.

3/North Carolina Reference and Industrial Directory, Department of Conservation and Development, Raleigh, North Carolina.

real and personal property.[4] If it is assumed that this proportion is representative of the unit, the assessed value of all forest land and timber was about 45 million dollars in 1937.

Taxes on forest land vary widely between counties and even between townships of the same county. For taxation purposes forest land is generally classified by tax assessors as wasteland, cutover land, woodland and timber land. Very little uniformity exists between counties in their allocation of forest land into these 4 classes. Data obtained in 1937 in the counties mentioned above provide an indication of the range in assessments, tax rates, and taxes per acre but radical variations from these values may exist in adjacent counties or townships. Wasteland was assessed at $1.25 to $5.85 per acre, cutover land at $5.91 to $9.91, woodland at $3.75, and timberland at $4.48 to $16.16 per acre. The average tax per acre varied from 2.3 cents on wasteland to 29.2 cents on timberland. The county-wide tax rate, exclusive of special school or road district levys, ranged from $1.25 to $1.81 per $100 of assessed valuation.

The ownership of forest land is approximately as shown in table 1. Federal lands consist of the forested portion of Fort Bragg Military Reservation in Hoke and Cumberland Counties, the portion of the Croatan National Forest lying in Jones County, and two areas leased to the North Carolina Department of Conservation and Development; one in Richmond, Moore, and Scotland Counties, and the other in Bladen County.

State lands are made up of school lands held in scattered tracts by the State Board of Education, the Hoffman Forest in Jones and Onslow Counties that is controlled by a Forestry Foundation and used as a school forest by North Carolina State College, and an area in Pender and Onslow Counties transferred from the State Board of Education to the Department of Conservation and Development in 1939.

Farm woodlands comprise about half of the forest land held in private ownership. The average farm contains 34 acres of woodland. Nearly every farm contains some wooded acreage so that the 2.5 million acres of farm forest are controlled by almost 73,000 different operators. Johnston County has the most farm woodland (219,000 acres) but Brunswick County, with 76 percent of all its farm-owned land in forest, has the highest proportion.[5] The industrial and other private owners who possess 2.7 million acres of forest land are chiefly pulp and paper companies, lumber companies, investment concerns, railroads and private estates. Ownership records show that approximately 10 percent is in ownerships of 50,000 acres or more, 10 percent is in tracts of 10,000 to 50,000 acres, and the rest is in holdings of less than 10,000 acres.

Sustained yield forestry is not widely practiced. Two pulp companies have together about 100,000 acres under sustained yield. Approximately 240,000 acres, owned by 13 lumber, box, pulp and veneer companies, are

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[4] Nelson, R. W.; Taxation of Forest Property in North Carolina, Forest Taxation Inquiry, U. S. Forest Service.

[5] United States Department of Commerce, Census of Agriculture, 1935.

being managed with sustained yield as the ultimate objective. It is probable that many owners of small private holdings are on sustained yield but the acreage so handled is not known.

Table 1. - Ownership of forest land, 1939.

Ownership	Distribution of forest area	
	Acres	Percent
Federal:		
Military Reservations	110,500	)
National Forests	26,400	) 4
Leased to N. C. Dept. of Cons. and Dev.	100,000	)
State:		
State Board of Education	35,000	)
Forestry Foundation (State College)	82,000	) 3
North Carolina Dept. of Cons. and Dev.	40,000	)
Private:		
Farm Woodlands[1/]	2,452,700	44
Industrial and other private	2,697,700	49
Total all forest land	5,544,300	100

1/1935 Census of Agriculture.

After more than 200 years of settlement only 30 percent of the land is used for agricultural crops (table 2). There are, however, many farms (73,000) and a large farm population. Throughout much of the unit, tobacco, cotton, and garden truck are produced by intensive farming on small acreages. The prevalence of forest land is due in part to this small-scale farming and, to a greater degree, to the prevailing soil and drainage conditions. Certain of the sand-hill soils are so sterile that crop production is impractical. Wide areas in the Tidewater counties will remain forested as past experience indicates the value of these soils for agriculture does not justify the cost of drainage. More than three-fourths of the Tidewater area is forested, compared to less than two-thirds of the Western Coastal Plain. The heavy demand made upon soil fertility by tobacco culture leads to a slow cycle of tobacco-land abandonment and forest-land clearing for new cropland (table 2).

Table 2. - Total land area classified according to major use, 1937

Land use[1/]	Area	Proportion of total area
	Acres	Percent
Forest:		
Productive[2/]	5,544,300	66.5
Nonproductive	13,800	.2
Total forest	5,558,100	66.7
Nonforest:		
Agriculture:		
Old cropland	2,327,300	27.9
New cropland	84,600	1.0
Pasture	82,100	1.0
Total agriculture	2,494,000	29.9
Abandoned cropland	47,200	0.6
Other nonforest	234,200	2.8
Total nonforest	2,775,400	33.3
Total area	8,333,500	100.0

1/Refer to glossary for description of terms.

2/Productive forest area used throughout the report.

DESCRIPTION OF THE FOREST RESOURCE

As early as 1894 W. W. Ashe[1/] observed that "The distribution of the pines and the respective area occupied by each in this state has changed a great deal since the first exploration of the country." Of the original coastal plain forest he states, "The longleaf pine formerly extended over the entire area under consideration, growing upon the drier portion of the sand. In the southern and southwestern counties it formed a forest of pine unmixed with other trees. Loblolly pine was originally confined to the lower and moister land, especially where it was loamy or slightly clayey, over the entire coastal region and westward beyond it about 40 miles."

Species and Forest Types

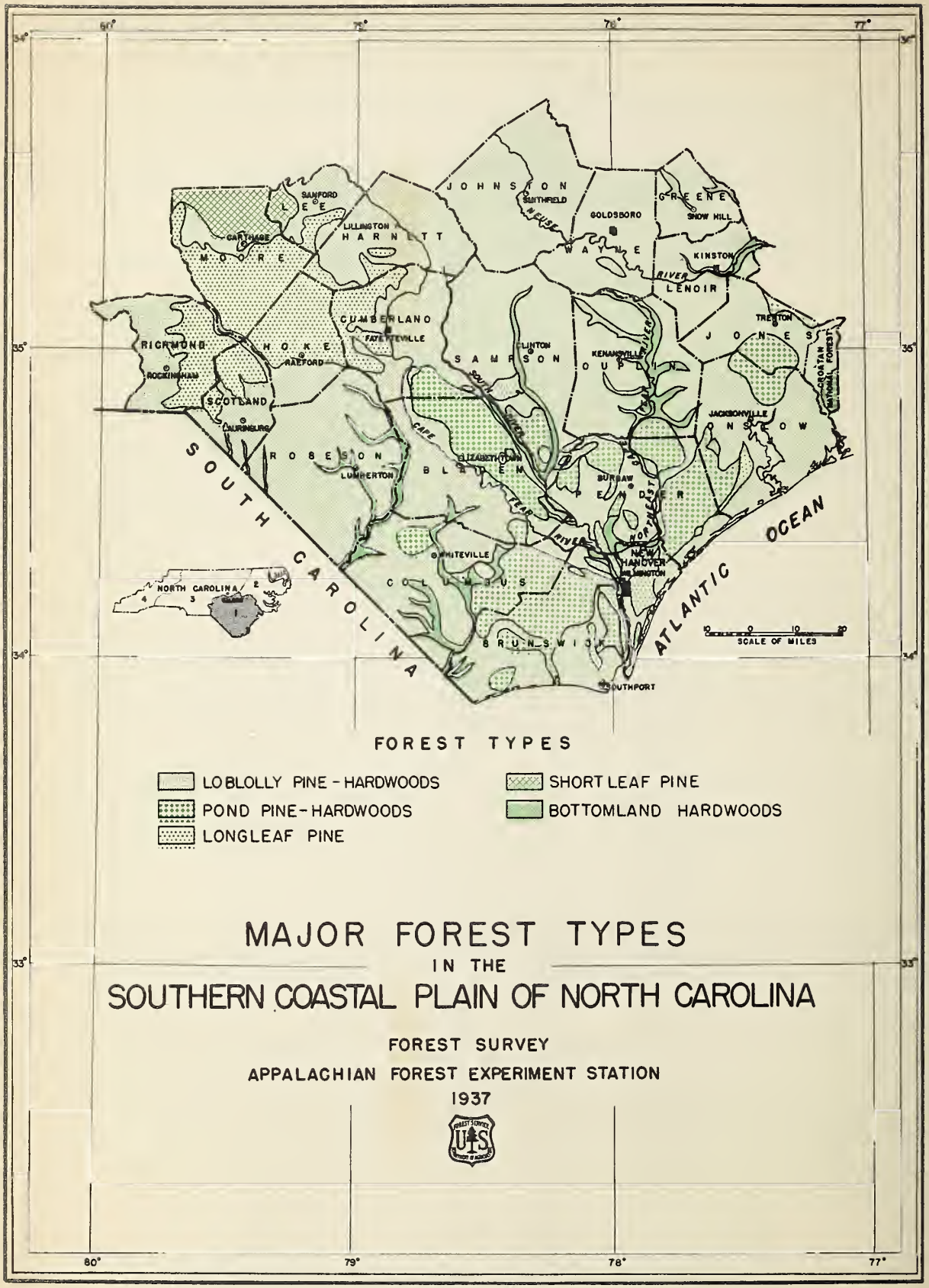
In the present-day forest longleaf pine is of minor importance. Only scattered stands occur in the Tidewater country; notably around Wilmington in New Hanover County, south of Jacksonville in Onslow County, and around Parkersburg in Sampson County. A fairly large area of second-growth longleaf pine occupies the Sandhills, chiefly in Richmond, Moore, Hoke and Scotland counties. Here the black jack and turkey oaks are associated with it, while on the lower land near the coast, loblolly and pond pines make up an appreciable part of the longleaf type.

Pond pine is more widely distributed than longleaf pine. It is very abundant in White Oak, Angola, Holly Shelter, and Green Swamps, also along the South River in Bladen and Sampson Counties, and in northwestern Pender County (fig. 2). Stands of pond pine are more nearly homogeneous in composition than other stands in the unit but a considerable volume of loblolly and longleaf pine, black, red, and tupelo gum, white cedar, and cypress is found in the pond pine-hardwoods type (table 3).

Loblolly pine is the most plentiful species in the unit. It occupies all topographic situations and is associated with all species, except with cypress and tupelo in the wettest swamps. It accounts for 76 percent of the volume in the loblolly pine-hardwood type and for 7 to 10 percent of the volume in each of the other types (table 3).

Many hardwood species flourish throughout the unit but no single species dominates the forest stand over wide areas. Hardwood trees are an integral part of the extensive pine types but the hardwood types are found along the streams, on flats bordering the larger swamps, and in scattered patches in the uplands. Because of differences in quality and proportionate occurrence of species the hardwood stands were classified in 2 broad types: the bottomland hardwoods and the upland hardwoods. Black, red, and tupelo gums make up more than half of the volume in the bottomland hardwood type. The oaks are most common in the upland hardwood type.

1/Ashe, W. W. The Forests, Forest Lands, and Forest Products of Eastern North Carolina. Bul. 5., North Carolina, Geological Survey, 1894.


FOREST TYPES
LOBLOLLY PINE - HARDWOODS
POND PINE - HARDWOODS
LONGLEAF PINE
SHORT LEAF PINE
BOTTOMLAND HARDWOODS
MAJOR FOREST TYPES
IN THE
SOUTHERN COASTAL PLAIN OF NORTH CAROLINA
FOREST SURVEY
APPALACHIAN FOREST EXPERIMENT STATION
1937
SOUTH CAROLINA
ATLANTIC OCEAN
SCALE OF MILES
JOHNSTON
GREENE
WAYNE
LENOIR
JONES
CRAVEN
PAMLICO
CARTERET
MOORE
LEE
HARNETT
CUMBERLAND
HOKE
SAMPSON
DUPLIN
ONSLOW
PENDER
BLADEN
ROBESON
RICHMOND
SCOTLAND
COLUMBUS
BRUNSWICK
NEW HANOVER
PASQUOTANK
CAMDEN
CURRITUCK
GATES
PERQUIMANS
CHOWAN
PERSON
ORANGE
DURHAM
WAKE
GRANVILLE
VANCE
WARREN
FRANKLIN
NASH
EDGECOMBE
HALIFAX
NORTHAMPTON
WILSON
GREENE
PITT
MARTIN
BERTIE
HERFORD
GATES
CHOWAN
PERQUIMANS
PASQUOTANK
CAMDEN
CURRITUCK
DARE
HYDE
TYRRELL
WASHINGTON
MARTIN
BERTIE
HALIFAX
NORTHAMPTON
VANCE
WARREN
FRANKLIN
GRANVILLE
PERSON
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CRAVEN
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CARTERET
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PENDER
BRUNSWICK
COLUMBUS
BLADEN
ROBESON
SAMPSON
DUPLIN
HOKE
MOORE
LEE
HARNETT
JOHNSTON
CUMBERLAND
RICHMOND
SCOTLAND
ROCKINGHAM
SANFORD
CARTHAGE
LILLINGTON
FAYETTEVILLE
RAEFORD
LAURINBURG
LUMBERTON
ELIZABETHTOWN
WHITEVILLE
SOUTHPORT
WILMINGTON
BURGAW
KENANSVILLE
CLINTON
SMITHFIELD
GOLDSBORO
SNOW HILL
KINSTON
TRENTON
JACKSONVILLE
CROATAN NATIONAL FOREST
CAPE FEAR RIVER
NORTHEAST CAPE FEAR RIVER
NEUSE RIVER
NORTH CAROLINA
80°
79°
78°
77°
35°
34°
33°

Figure 2

Table 3. - Species composition of the forest types.

Species	Loblolly pine-hardwoods[1/]	Pond pine-hardwoods	Longleaf pine	Upland hardwoods	Bottomland hardwoods	All types
	Percent of cubic volume (o.b.)					
Loblolly pine	75.7	6.8	8.7	9.6	7.8	43.9
Pond pine	1.2	81.7	4.6	Negl.	0.6	8.3
Longleaf pine	2.5	3.6	78.8	2.6	0.1	6.6
Shortleaf pine	4.4	Negl.	0.1	3.3	0.1	2.5
White cedar	0.1	0.7	Negl.	--	0.7	0.3
Cypress	0.3	0.5	Negl.	0.1	8.6	2.6
Red gum	3.8	0.4	0.3	10.9	14.9	6.7
Black and tupelo gum	3.7	3.8	0.8	3.0	37.0	12.9
Yellow poplar	1.0	0.6	0.2	3.6	2.9	1.5
Red oaks	2.3	Negl.	1.3	19.6	6.4	3.9
White oaks	2.0	Negl.	1.0	23.4	2.1	2.6
Ash	Negl.	--	--	0.8	4.1	1.2
Holly, dogwood, persimmon	0.4	Negl.	0.1	1.5	0.8	0.5
Scrub hardwoods[2/]	0.8	0.2	3.9	6.9	1.4	1.3
Other hardwoods	1.8	1.7	0.2	14.7	12.5	5.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

1/Includes the shortleaf pine-hardwoods type.
2/Scrub oaks, redbud, sassafras, etc.

The loblolly pine-hardwood type, occupying over 40 percent of the forest area, is the most extensive in the unit (table 4). Because this type has restocked abandoned fields and cut-over longleaf land it is widely distributed in the lowlands and rolling uplands. Nearly 20 percent of the forest area is in the pond pine-hardwood type, located chiefly in the less accessible swamps and flatwoods. Logging and frequent fires have reduced the saw-timber area in this type, but sprout growth and natural seeding have produced large areas of reproduction and young second growth. The longleaf pine type, once the most extensive in area, now occupies only 815,000 acres, 15 percent of the forest land. It is about equally distributed between the rolling uplands of the Sandhills and the level lowlands of the Tidewater counties. It is probable that this type will be gradually replaced by loblolly-hardwoods, except on the Sandhills. The upland hardwood type, chiefly on the rolling uplands, is found on only 7 percent of the forest area. Scrub oak stands having little value make up nearly one-third of the area of this type. Seventeen percent of the forest land is in bottomland hardwoods type. Slightly more than half is in the main river bottoms, the rest is in swamps and level lowlands. Bladen, Columbus, Duplin, and Robeson counties contain the largest concentrations of bottomland hardwoods.

Table 4. - Forest area classified according to forest type and topography, 1937

Forest type	Rolling uplands	Level lowlands	Swamps bays, and ponds	River bottoms	Total	Proportion of total
			Acres			Percent
Loblolly pine-hardwoods	772,600[1/]	1,270,200	191,000	83,000	2,316,800	41.8
Pond pine-hardwoods	26,000	247,200	792,900	--	1,066,100	19.2
Longleaf pine	390,300	424,500	--	--	814,800	14.7
Upland hardwoods	325,200	78,900	--	--	404,100	7.3
Bottomland hardwoods	--	122,000	298,400	522,100	942,500	17.0
Total	1,514,100	2,142,800	1,282,300	605,100	5,544,300	100.0
Percent of total	27.3	38.7	23.1	10.9	100.0	

1/Includes 133,400 acres in the shortleaf pine-hardwoods type.

Forest Conditions

About half of the forest land supports stands of sawlog size (table 5). One-fourth of the area in these merchantable stands contains old-growth timber, much of which has been sorted over for the best quality logs or for particular species. Three-fourths, or 2.1 million acres, of the sawlog-size stands are second-growth timber. Nearly two-thirds of the total second-growth saw-timber acreage is in the loblolly pine-hardwoods type.

Under-sawlog-size stands occupy 49 percent of the total forest area. They contain a large volume of young growing stock that will contribute to the volume of saw timber in the future. The acreage of young second growth is fairly evenly divided among the forest types but two-fifths of the reproduction area is located in the pond pine-hardwoods type. Only 2 percent of the forest land is clear-cut. This acreage is distributed throughout the unit in small tracts, most of which will restock naturally if protected from fire.

Within each forest type there is a predominant forest condition. The loblolly pine-hardwood type has the highest proportion (60 percent) of its area in second-growth sawlog-size stands. Types having a large share of their area in under-sawlog-size stands include: pond pine-hardwoods, 63 percent; longleaf pine, 76 percent; upland hardwoods, 75 percent. The bottomland hardwoods type has 38 percent of its area stocked with old-growth stands.

Table 5. - Forest area classified according to forest condition and forest type, 1937

Forest condition	Loblolly pine hard-woods[1/]	Pond pine-hard-woods	Long-leaf pine	Upland hard-woods	Bottom-land hard-woods	Total all types	Proportion of total
	Acres						Percent
Sawlog size:							
Old growth:							
Uncut	44,700	75,700	6,500	2,400	138,200	267,500	4.8
Partly cut	94,400	48,000	64,200	30,900	216,300	453,800	8.2
Total	139,100	123,700	70,700	33,300	354,500	721,300	13.0
Second growth:							
Uncut	740,800	211,400	89,400	28,500	165,100	1,235,200	22.3
Partly cut	650,600	56,900	31,800	39,800	100,000	879,100	15.8
Total	1,391,400	268,300	121,200	68,300	265,100	2,114,300	38.1
Total sawlog size	1,530,500	392,000	191,900	101,600	619,600	2,835,600	51.1
Under sawlog size:							
Second growth	662,700	438,300	461,100	280,500	224,500	2,067,100	37.3
Reproduction	87,800	206,600	116,300	22,000	89,400	522,100	9.4
Clear-cut	35,800	29,200	45,500	--	9,000	119,500	2.2
Total under sawlog size	786,300	674,100	622,900	302,500	322,900	2,708,700	48.9
Total all conditions	2,316,800	1,066,100	814,800	404,100	942,500	5,544,300	100.0
Percent of total forest area	41.8	19.2	14.7	7.3	17.0	100.0	

[1/] Includes shortleaf pine-hardwoods type.

Site

Site quality determines the timber producing power of forest land. A commonly accepted index of site quality is the height growth of average dominant forest trees. In the extensive area occupied by loblolly pine the forest land was classified according to site quality on the basis of the total height of dominant loblolly pine trees at 50 years of age. This classification showed that such areas are capable of producing excellent stands of loblolly pine because nearly 80 percent of the area had at least a 70-foot site index. The rolling uplands are least productive; the best sites are those in the bottomlands of the larger rivers. The occurrence of sites by topographic divisions is given on the next page.

Topographic division	Site index in feet		
	90 or more	70 and 80	60 or less
	Percent of area		
Rolling uplands	3	70	27
Level lowlands	2	76	22
Bays, ponds, swamps	5	84	11
River bottom lands	13	84	3
Average	3	75	22

Age

The dominant trees in the old-growth stands of both pine and hardwood range in age from 70 to 300 years. Second-growth sawlog-size pine stands are characterized by trees 30 to 60 years old, although pond pine stands of this size class are often 10 to 20 years older. In the hardwood stands the merchantable second-growth trees are commonly 50 to 90 years old. Second-growth pine and hardwood stands below sawlog size contain a preponderance of trees 15 to 25 years old, but they range in age from 10 to 50 years. Practically all the trees in the reproduction condition are less than 10 years old.

Stocking

Natural restocking has produced a stand of second-growth trees on practically all of the cut-over forest land. Frequent fires, cutting and the vagaries of natural seeding have created an irregular stand with stocking that varies from thin to above normal. In the pine types the average cordwood volumes per acre of uncut stands on the best-stocked 10 percent of the pine area correspond approximately with full stocking as determined by MacKinney and Chaiken.[2/] A comparison of the average cordwood volume per acre in representative age-classes of all uncut stands with these fully stocked stands shows that understocking is prevalent throughout the pine area (table 6). The younger average stands are most poorly stocked, only 36 percent in the 21 to 30 year age-class, but as they grow older stocking gradually improves for the 51 to 60 year-old average stands are 55 percent stocked.

2/MacKinney, A. L., and Chaiken, L. E., Volume, Yield, and Growth of Loblolly Pine in the Mid-Atlantic Coastal Region. Tech. Note No. 33, Appalachian Forest Experiment Station, April, 1939.

Table 6. - Average volumes per acre, by age-classes, in the uncut conditions of the pine-hardwood types

Age-class (years)	Based on all stands	Based on best 10 percent of stands	Relation of all stands to best 10 percent
	Cords		Percent
21 - 30	6.4	18.0	36
31 - 40	13.0	28.5	46
41 - 50	19.2	37.0	52
51 - 60	24.1	43.9	55
Weighted average of all age-classes	10.2	23.5	43

Intensive forest management should produce volumes per acre closely approaching those on the best 10 percent of the pine area, but there is little likelihood of intensive forestry being applied immediately on a unit-wide scale. Minimum measures which are entirely practical and reasonable, such as more effective fire control and conservative cutting, should increase the average volume per acre by at least one-half, or from 10 up to 15 cords. Obvious benefits are greater yields per unit of area owned, more raw material for dependent wood-using industries, and better quality timber.

Fire

At the time of the survey in 1937 indications of past fires were discernible on 82 percent of the forest land. The burned acreage has accumulated over a period of years, as only a small part of the forest is burned over in a normal year. The frequency and intensity of fire varies noticeably with the forest type. Practically all of the pond pine-hardwood type has been burned over, and on 22 percent of its area the fire was heavy enough to kill saw-timber trees. Ninety-eight percent of the longleaf type showed evidence of fire, but serious injury to the trees and reproduction was apparent on only 19 percent of the area. The loblolly pine-hardwood type had a smaller proportion (80 percent) of its area burned. In this type the reproduction and smaller trees are often killed outright and after a short time the dead trees decay and disappear so that the damage is less noticeable. Evidence of past fires was present on 84 percent of the upland hardwood acreage and 52 percent of the bottomland hardwood. Although generally of light intensity, these fires kill the young trees and are responsible for a large part of the butt-rot in the hardwoods.

THE VOLUME OF THE FOREST RESOURCE

Estimates of the volume of sound wood in this area are presented in board feet, in cords, and in cubic feet. The board-foot volume includes only sound sawlog-size trees and is the material suitable for such products as lumber, veneer, and crossties. The cordwood volume includes both the board-foot material and the sound material in culls, tops, and small trees. Both wood and bark are included in cordwood but not in cubic-foot volumes, otherwise these volumes are identical.

Board-foot Volume[1/]

The net board-foot volume of standing timber is 12.3 billion board feet, expressed in the International $\frac{1}{4}$-inch log rule (table 7). In this table the same volume of wood is also computed by the Scribner and Doyle log rules, affording a comparison of the results obtained with these widely used scales. The noticeably smaller volumes obtained with the Doyle rule are primarily the result of several factors: (1) the rule greatly under-scales small logs, (2) a large part of both the pine and hardwood saw timber is in second-growth stands containing a high proportion of small trees, (3) pine trees down to 9.0 inches d.b.h. and hardwood trees down to 13.0 inches d.b.h. are included in the board-foot volume. The lower diameter range in the pine contributes to the wide difference between the Doyle and International volumes, a disparity that is less noticeable in the larger hardwoods.

More than half of the total saw timber and three-fourths of the pine saw timber is in a single species -- loblolly pine (table 8). Black and tupelo gums are the principal hardwood species, making up 10 percent of the total board-foot volume and 35 percent of the hardwood volume.

One fourth of the pine volume and two-thirds of the hardwood volume is in old-growth stands. About half of this old-growth volume is in stands that have been subjected to one or more cuttings which usually removed the highest quality material. Part of the volume is in second-growth trees that occur in the old-growth stands. Only 22 percent of the loblolly pine volume is in the old-growth condition in contrast to 80 percent of the black and tupelo gum volume.

1/See glossary for detailed description of material included in board-foot volume.

Table 7. - Net volume by the International, Scribner, and Doyle rules classified according to species-group, 1937

Species-group	International[1/]	Scribner	Doyle
	Thousand board feet		
Pines:			
Loblolly	6,367,700	5,458,000	3,699,100
Pond	1,001,600	833,400	515,400
Longleaf	837,000	710,000	472,900
Shortleaf	246,200	202,200	124,300
Total pines	8,452,500	7,203,600	4,811,700
Hardwoods:			
Black gums[2/]	1,184,700	1,091,100	874,400
Red gum	843,000	770,500	603,600
Yellow poplar	221,900	202,900	158,000
Red oaks	421,900	389,400	325,700
White oaks	163,800	152,200	125,400
Ash	105,200	95,100	71,800
Other hardwoods	400,900	354,200	276,600
Total hardwoods	3,341,400	3,055,400	2,435,500
Cypress[3/]	467,100	411,700	293,600
Total all species	12,261,000	10,670,700	7,540,800

1/The scale by this rule approximates green lumber tally.
2/Includes black and tupelo gums throughout the report.
3/Seven percent of this volume is white cedar.

The second-growth volume is 62 percent of the total board-foot volume, or 7.7 billion feet. Six-tenths of this volume is in second-growth stands that have been undisturbed by cutting, where the volumes per acre are generally favorable for logging. The partly-cut second-growth stands contain three-tenths of the second-growth volume. Cutting in these stands usually has removed the larger trees and more valuable species. One-tenth of the second growth is in scattered sawlog-size trees in under-sawlog-size stands. Some of these trees are residual from earlier stands, but the larger part are so young that they have only recently attained sawlog size. Many of those adjacent to saw-timber stands will be cut, but the small scattered ones probably will not be utilized in the near future.

Table 8. - Net volume by the International $\frac{1}{4}$-inch rule classified according to species-group and forest condition, 1937

Species-group	Sawlog size				Under sawlog size[1]	Total	Proportion of total
	Old growth		Second growth				
	Uncut	Partly cut	Uncut	Partly cut			
	Thousand board feet						Percent
Pines:							
Loblolly	745,700	634,500	3,128,700	1,582,300	276,500	6,367,700	51.9
Pond	234,500	102,700	432,300	99,100	133,000	1,001,600	8.2
Longleaf	38,900	284,300	264,000	104,800	145,000	837,000	6.8
Shortleaf	19,100	15,400	70,700	121,800	19,200	246,200	2.0
Total pines	1,038,200	1,036,900	3,895,700	1,908,000	573,700	8,452,500	68.9
Hardwoods:							
Black gums	439,900	505,900	138,100	80,900	19,900	1,184,700	9.7
Red gum	265,700	252,600	182,700	121,400	20,600	843,000	6.9
Yellow poplar	21,500	65,500	89,800	42,400	2,700	221,900	1.8
Red oaks	94,800	139,900	118,400	56,900	11,900	421,900	3.5
White oaks	29,400	64,700	38,600	24,300	6,800	163,800	1.3
Other hdwds.[2]	173,900	148,000	114,100	51,400	18,700	506,100	4.1
Total hardwoods	1,025,200	1,176,600	681,700	377,300	80,600	3,341,400	27.3
Cypress	200,900	128,400	75,900	49,700	12,200	467,100	3.8
Total all species	2,264,300	2,341,900	4,653,300	2,335,000	666,500	12,261,000	100.0
Percent of total	18.5	19.1	38.0	19.0	5.4	100.0	

1/Includes the reproduction and clear-cut conditions.
2/Includes chiefly ash, maple, bay, hickory, elm, beech and birch.

A large part of the board-foot volume is in small trees (fig. 3). Forty-two percent of the pine volume is in the 10- and 12-inch d.b.h. classes. These sizes are commonly used for lumber but larger trees would yield better quality material and provide more opportunity for profit. Only 40 percent of the hardwood and cypress volume is in trees 20 inches and larger, where most of the first-grade logs occur.

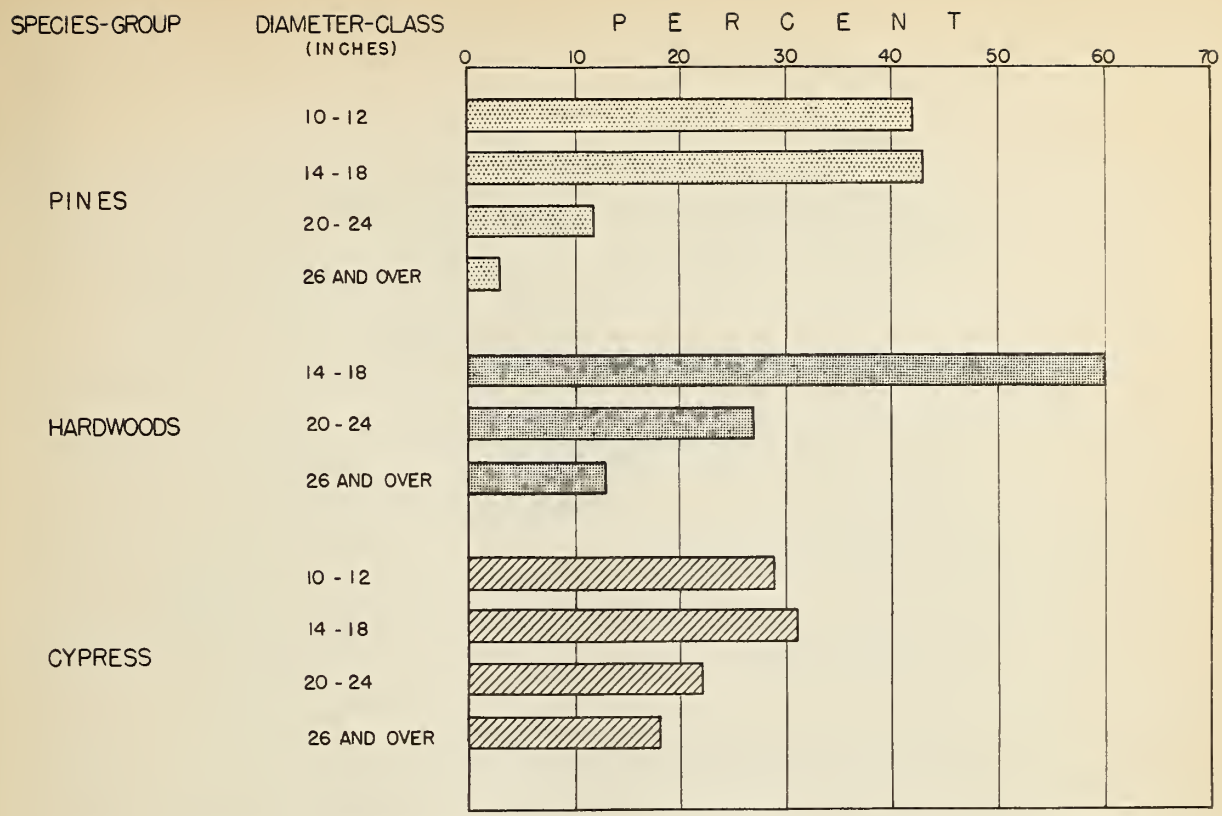
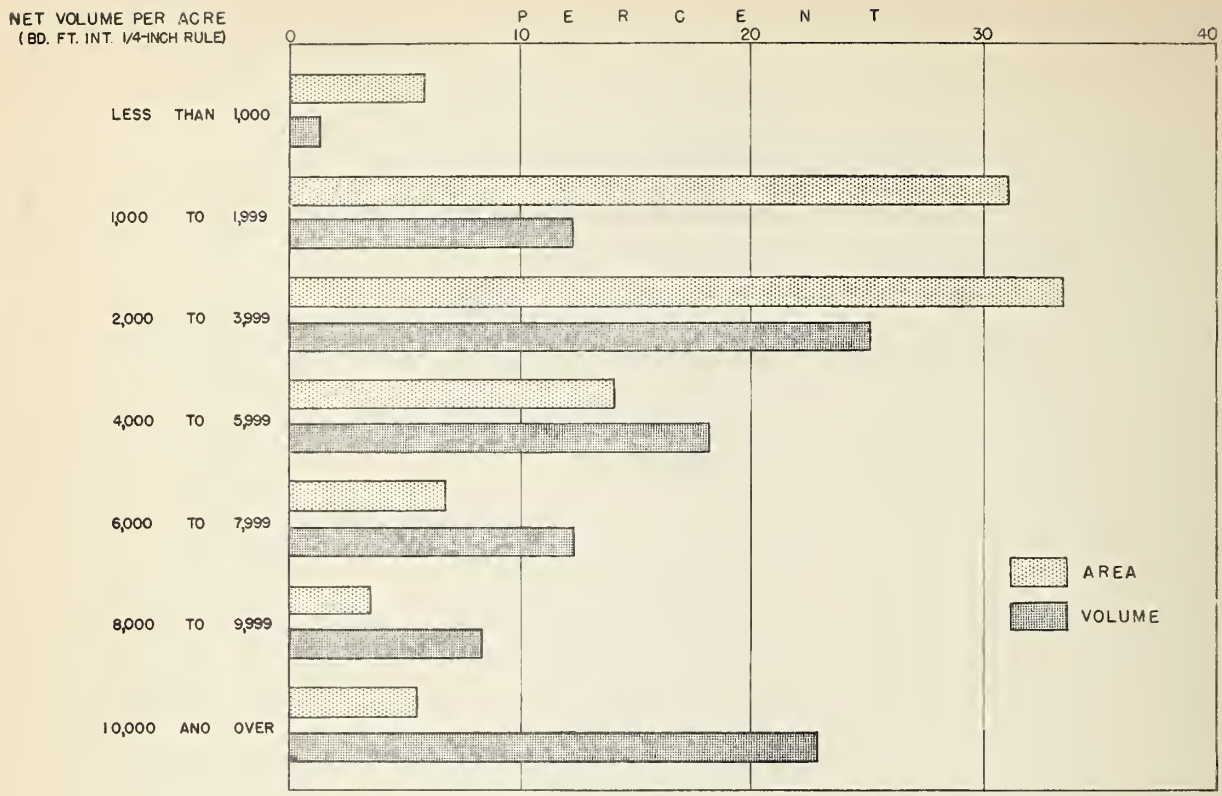


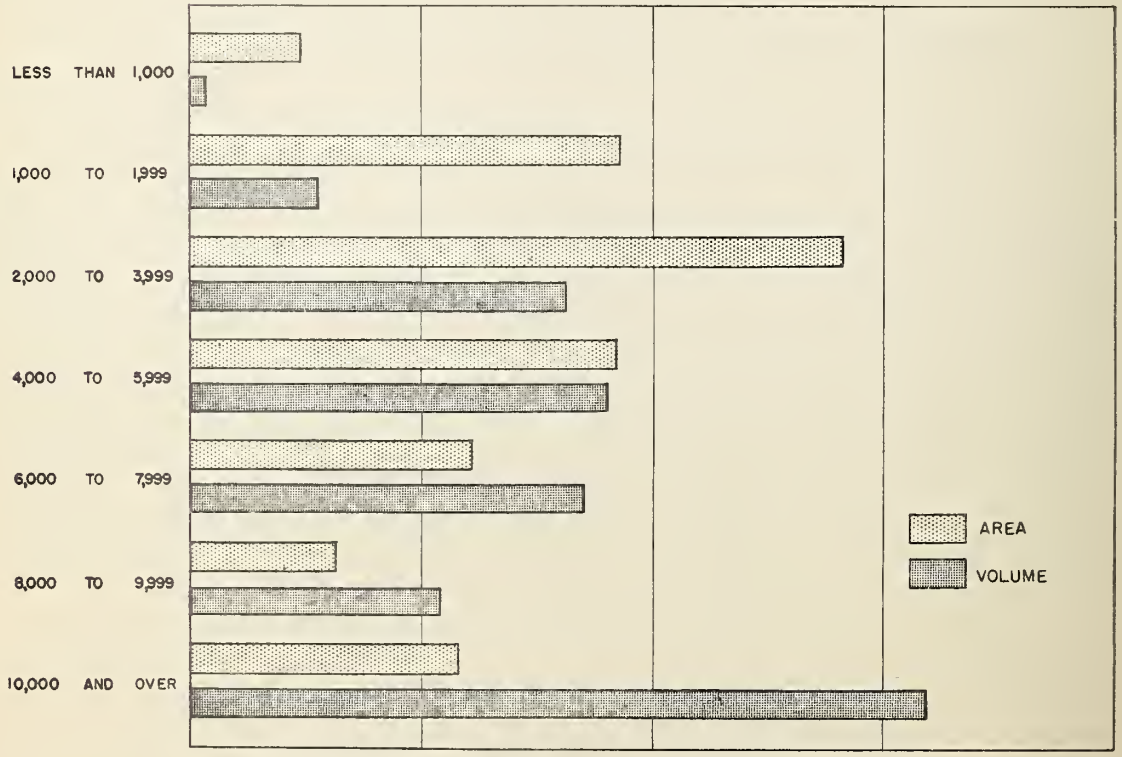
FIGURE 3.- DIAMETER DISTRIBUTION OF BOARD-FOOT VOLUME (INTERNATIONAL 1/4-INCH RULE)

A measure of the economic availability of the board-foot volume in the sawlog-size stands is the average volume per acre (fig. 4). The pine and pine-hardwood types (loblolly pine-hardwoods, pond pine-hardwoods, and longleaf pine) occupy 2.1 million acres and contain 7.9 billion board feet. Eighty-seven percent of this volume is in stands of more than 2,000 board feet per acre and 23 percent is in stands of more than 10,000 board feet. Thirty-seven percent of the area is stocked with less than 2,000 feet per acre. This pine area is considerably understocked (table 6) but the degree of understocking on the area as a whole is difficult to estimate without a detailed determination of the age-class distribution. Nearly 30 percent of the area is stocked with stands less than 40 years old; such young stands normally have a rather low board-foot volume and on the basis of table 6 have, on the average, poorer stocking than the older stands.

The sawlog-size stands in the hardwood types (upland and bottom-land hardwoods) occupy 721,000 acres and contain 3.7 billion board feet. Ninety-four percent of the volume is in stands of more than 2,000 board feet per acre and 32 percent is in stands of more than 10,000 board feet. Only one-fourth of the area is stocked with less than 2,000 feet per acre.



A.- PINE AND PINE-HARDWOOD TYPES



B.- HARDWOOD TYPES

FIGURE 4.- DISTRIBUTION OF AREA AND BOARD-FOOT VOLUME IN THE SAWLOG-SIZE CONDITIONS, CLASSIFIED ACCORDING TO VOLUME OF SAW TIMBER PER ACRE.

Consideration of the total board-foot volume in the unit, both pine and hardwood, reveals that 84 percent is in sawlog-size stands of more than 2,000 board feet per acre.

A small proportion of the volume in the pond pine pocosins and larger swamps is inaccessible according to present standards. In parts of Green, Holly Shelter, Angola, and White Oak swamps the volume per acre is so low and the physical difficulties so great that logging is not practical. Probably less than 5 percent of the total volume is so situated.

The average board-foot volume per acre, within a given forest condition, varies noticeably by forest type (table 9). In the old-growth uncut condition of the loblolly pine-hardwood type the average stand per acre is nearly 16,000 board feet, in contrast to 3,100 feet in the same condition of the pond pine-hardwoods type. The values given in this table are a useful guide to the average volumes in the different forest types and conditions of this unit. Although not applicable to a small area, these values will give an approximation of the board-foot volume on an extensive acreage if its area composition by forest types and conditions is first roughly determined.

Table 9. - Average board-foot volume per acre classified according to forest type and forest condition, 1937

Forest type	Sawlog size					Under sawlog size[1]	Weighted average of all conditions
	Old growth		Second growth		Weighted average		
	Uncut	Partly cut	Uncut	Partly cut			
	Thousand board feet[2]						
Loblolly pine-hardwoods	15.9	6.2	4.6	2.8	4.3	.3	2.9
Pond pine-hardwoods	3.1	2.5	2.0	2.0	2.3	.2	1.0
Longleaf pine	4.8	3.5	2.2	2.0	2.7	.2	.8
Upland hardwoods	7.5	3.5	1.9	1.7	2.4	.1	.7
Bottomland hardwoods	9.2	6.0	3.6	2.5	5.5	.3	3.7
Average all types	8.5	5.2	3.8	2.7	4.1	.2	2.2

1/Includes reproduction, and clear-cut areas.
2/Net volume (International $\frac{1}{4}$-inch rule).

Cordwood Volume[2/]

The net volume of sound material in all living trees 5.0 inches d.b.h. and larger, is 66.7 million standard cords (table 10). In the pines, nearly three-fourths of the volume is in sawlog-size trees. The 4.5 million cords in the upper stems of these larger trees is generally suitable for pulpwood when mixed with other better-quality material, but of course will not become available until the trees are felled for the saw-timber portion of the bole. Some part of the 7 million cords in sound pine trees under sawlog size should be removed in thinning operations, but the majority of these smaller trees should be left in the stand to contribute to the saw-timber growing stock. Allowing these smaller trees to grow to sawlog size builds up the supply of timber for the lumber industry, provides a more economical supply of wood for the pulpwood industry, and allows the timber owner to benefit from the rapid increase in volume and value made by stands in the early stages of merchantability. Although there are 1.3 million cords of sound material in cull pine trees, it will be utilized only in conjunction with pulpwood or fuelwood cuttings in better quality material, because of the scattered distribution of these cull trees.

Table 10. - Net cordwood volume of all sound material, 1937

Species-group	Source of material				Total	Proportion of total
	Sawlog-size trees		Sound trees under sawlog size	Cull trees		
	Sawlog material	Upper stems				
	Cords					Percent
Pines:						
Loblolly	14,779,400	3,194,500	4,366,200	549,700	22,889,800	34.3
Pond	2,402,200	704,900	1,104,700	653,900	4,865,700	7.3
Longleaf	1,934,400	421,200	975,800	95,500	3,426,900	5.1
Shortleaf	607,200	144,500	515,800	21,700	1,289,200	1.9
Total pines	19,723,200	4,465,100	6,962,500	1,320,800	32,471,600	48.6
Hardwoods:						
Black gums	3,232,500	1,640,200	4,166,200	2,737,900	11,776,800	17.6
Red gum	2,017,400	1,155,200	1,812,900	643,800	5,629,300	8.4
Yellow poplar	532,500	304,000	355,200	193,000	1,384,700	2.1
Red oaks	1,134,500	580,200	1,090,000	866,600	3,671,300	5.5
White oaks	435,300	227,800	1,061,400	334,600	2,059,100	3.1
Other hdwds.	1,311,400	668,700	2,642,000	3,133,700[1/]	7,755,800	11.7
Total hdwds.	8,663,600	4,576,100	11,127,700	7,909,600	32,277,000	48.4
Cypress	1,108,700	299,000	370,900	207,200	1,985,800	3.0
Total all species	29,495,500	9,340,200	18,461,100	9,437,600	66,734,400	100.0
Percent of total	44.2	14.0	27.7	14.1	100.0	

1/Includes scrub oak and non-commercial species.

2/See glossary for description of material included in cordwood volume.

About three-fifths of the hardwood volume is in cull trees and sound trees below sawlog size. The discussion of the pine volume above, applies in general to the hardwoods, with the exception that cull hardwoods sometimes make up enough volume in a specific locality to warrant utilization. This is particularly true of the black and tupelo gums where many of the trees have too much sweep to be classed as saw timber, but are entirely satisfactory for pulpwood. Nearly one-fourth of the volume in these species is in cull trees.

The distribution of the net cordwood volume among the several tree diameter-classes is presented in table 11. The volume of 52.4 million cords shown here does not include the sound volume in cull trees (9.4 million cords) or the volume in upper-stems and limbs of sawlog-size hardwoods and cypress (4.9 million cords). Fifty-eight percent of the total volume is in trees 5.0 to 13.0 inches in diameter. These small trees are the best size for pulpwood but a large proportion of them must be left to meet future needs for saw timber and other higher quality products.

Table 11. - Net cordwood volume of sound trees classified according to species-group and diameter-class, 1937

Species-group	Tree diameter-class (inches)				Total	Proportion of total
	6 - 8	10 - 12	14 - 18	20 and over		
	Cords (bark included)					Percent
Pines:						
Loblolly	4,366,200	8,341,300	7,326,100	2,306,500	22,340,100	42.6
Pond	1,104,700	1,758,200	1,216,000	132,900	4,211,800	8.0
Longleaf	975,800	1,091,800	1,000,100	263,700	3,331,400	6.4
Shortleaf	515,800	537,100	153,700	60,900	1,267,500	2.4
Total pines	6,962,500	11,728,400	9,695,900	2,764,000	31,150,800	59.4
Hardwoods:						
Black gums	1,639,600	2,526,600	2,011,200	1,221,300	7,398,700	14.1
Red gum	791,700	1,021,200	1,337,000	680,400	3,830,300	7.3
Yellow poplar	128,400	226,800	376,500	156,000	887,700	1.7
Red oaks	482,000	608,000	557,200	577,300	2,224,500	4.3
White oaks	508,800	552,600	232,400	202,900	1,496,700	2.9
Other hdwds.	1,301,600	1,323,800	1,011,000	317,000	3,953,400	7.5
Total hdwds.	4,852,100	6,259,000	5,525,300	3,154,900	19,791,300	37.8
Cypress	370,900	360,000	379,000	382,800	1,492,700	2.8
Total all species	12,185,500	18,347,400	15,600,200	6,301,700	52,434,800	100.0
Percent of total	23.2	35.0	29.8	12.0	100.0	

The average stand of cordwood per acre in sound trees (excluding cull trees and upper stems and limbs of sawlog-size hardwoods and cypress) is 9.5 cords (table 12). This average includes the light stands in the clear-cut, reproduction, and under-sawlog-size conditions, and is not a good criterion of the volume in sawlog-size stands. In the sawlog-size conditions the average stand per acre varies from 12 cords in partly-cut second growth to 27 cords in uncut old growth. The saw-timber stands in the loblolly pine-hardwoods type, occupying nearly 30 percent of the forest land, have the largest volumes of pine cordwood per acre, while the heaviest concentration of hardwood occurs in the sawlog-size conditions of the bottomland hardwoods type.

Table 12. - Average cordwood volume per acre, classified according to forest type and forest condition, 1937

Forest type	Sawlog size					Under sawlog size[1]	Weighted average of all conditions
	Old growth		Second growth		Weighted average		
	Uncut	Partly cut	Uncut	Partly cut			
	Cords						
Loblolly pine-hardwoods	42.5	18.9	18.0	12.0	16.2	3.2	11.8
Pond pine-hardwoods	10.5	9.3	8.5	7.7	8.9	1.5	4.2
Longleaf pine	14.4	10.1	10.3	7.9	10.0	1.7	3.7
Upland hardwoods	23.7	13.9	11.9	10.4	12.2	2.4	4.9
Bottomland hardwoods	32.2	23.2	21.0	14.3	23.2	3.9	16.6
Average all types	27.3	18.3	16.1	11.8	16.2	2.4	9.5

1/ Includes under-sawlog-size second growth, reproduction, and clear-cut areas.

Cubic-foot Volumes

The volumes shown in cords in table 10 are summarized in cubic feet in table 13. These cubic-foot volumes are for net sound wood only; bark is not included.

Table 13. - Net volume of all sound material expressed in cubic feet (inside bark), 1937

Species-group	Source of material				Total	Proportion of total
	Sawlog-size trees		Sound trees under sawlog size	Cull trees		
	Sawlog material	Upper stems[1/]				
	Thousand cubic feet					Percent
Pines	1,420,240	317,470	457,930	92,720	2,288,360	50.8
Hardwoods	585,060	270,990	706,360	505,920	2,068,330	45.9
Cypress	86,090	18,370	26,550	15,260	146,270	3.3
Total all species	2,091,390	606,830	1,190,840	613,900	4,502,960	100.0
Percent of total	46.5	13.5	26.4	13.6	100.0	

1/ Includes the upper stems of pine and cedar and the upper stems and limbs of hardwoods and cypress.

Poles and Piles

Many of the trees that contribute to the volumes given in previous tables are suitable for poles or piles. A separate tally was made of those trees that would meet the pole and pile specifications. The results are presented in table 14. Approximately 10 percent of the pine trees in the requisite sizes will make poles or piles. These trees occur scattered throughout the forest and a large proportion of them will be cut for lumber, pulpwood, or other uses rather than for poles.

Table 14. - Total number of pine poles and piles, classified according to length and diameter, 1937

D.b.h. of trees (outside bark)	Pole and pile length (feet)					Total	Proportion of total
	20	25	30	35	40 or over		
Inches	Thousand pieces						Percent
7.0 - 8.9	2,730	551	189	--	--	3,470	30.0
9.0 - 10.9	3,013	731	460	145	29	4,378	37.9
11.0 - 12.9	1,001	860	446	163	149	2,619	22.6
13.0 - 14.9	--	310	375	128	143	956	8.3
15.0 - 16.9	--	--	52	45	43	140	1.2
Total	6,744	2,452	1,522	481	364	11,563	100.0
Percent of total	58.3	21.2	13.1	4.2	3.2	100.0	

THE INCREMENT OF THE FOREST

Any commercial forest land-use enterprise, which has for its objective the continuous production of raw material for wood products, must consider its growing stock as forest capital. In this unit, the sound-tree volumes previously described must be so regarded. Under natural conditions this forest capital will increase each year through growth, and this yearly production of wood should serve as a basis for permanent industries. At present most of the forests of this unit are cut with little or no pretense of leaving a growing stock for the continuous production of wood crops, and as a result the quantity of wood produced each year is small compared with the growth potentialities of the soil and climate.

Increment of the Total Stand

The net volume of wood produced by growth of the forest growing stock is termed "forest increment". In tables 15 and 16 the calculations are based upon (1) the growth of the sound trees remaining in the stand, (2) the volume recruited from those sound trees that grew into measurable size during the year, and (3) the volume lost because of the mortality and decay resulting from forest fires, insect damage, disease, wind-throw, and tree competition. The first two items make up the total growth which must be reduced by the volume loss (item 3) in order to obtain net increment. In the various forest conditions there is a wide divergence in the effect of these three elements upon net increment. It is natural, because of old age, tree competition, and the cumulative effects of fire and insect damage, to have a high mortality in the old-growth conditions (figure 5) but the high mortality in the young second-growth hardwoods is somewhat unexpected and is due in part to the death of an occasional large-diametered residual hardwood in these young stands. Although few in number these high-volume trees account for much of the volume of mortality.

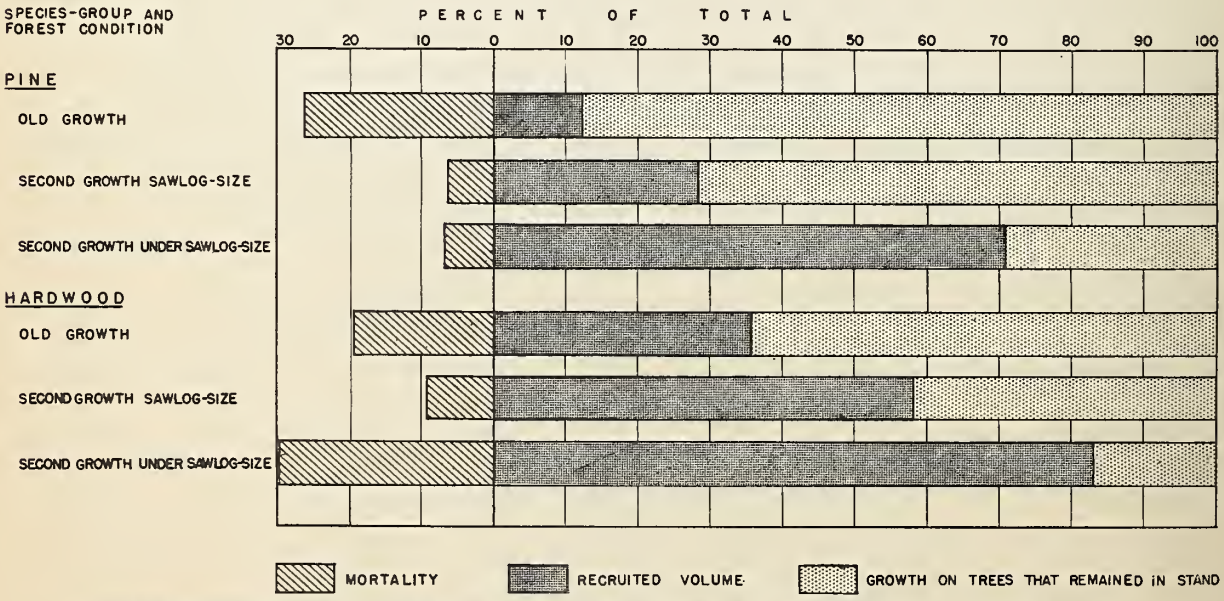


FIGURE 5.-PROPORTIONAL DISTRIBUTION OF THE ELEMENTS OF NET BOARD-FOOT INCREMENT

One of the most interesting features of figure 5 is the high proportion of the total growth recruited from trees reaching sawlog size during the year. This is, of course, most noticeable in the under-sawlog-size conditions but even in the old-growth hardwoods this recruited volume is more than one-third of the total growth; in the whole forest stand it is 38 percent.

In 1937 the total growth was 766 million board feet; from fire and natural causes losses were 77 million board feet, leaving a net increment of 689 million feet (table 15). Old-growth stands contributed about 16 percent of the increment; second growth 84 percent. About 45 percent of the hardwood increment, as compared to only 8 percent of the pine, was in old-growth stands. Nearly one-fifth of the pine increment was in trees located in under-sawlog-size stands, and consequently of rather low saw-timber quality. More than 85 percent of the total cubic-foot increment was in second-growth stands. Although hardwoods produced only 9 percent of the board-foot increment in the under-sawlog-size condition, they made up 19 percent of the cubic-foot increment in the same condition, due chiefly to the wider diameter-range (5.0 to 12.9 inches d.b.h.) in the under-sawlog-size hardwoods.

Table 15. - Net increment in board feet and cubic feet in the various forest conditions, 1937

Forest condition	Saw-timber material			All sound trees[1/]		
	Pine	Hardwood	Total	Pine	Hardwood	Total
	Thousand board feet			Thousand cubic feet (i.b.)		
Sawlog size:						
Old growth	41,800	68,300	110,100	7,380	15,240	22,620
Second growth	387,100	76,100	463,200	74,290	24,540	98,830
Under sawlog size:						
Second growth	100,200	9,800	110,000	37,270	8,700	45,970
Reproduction and clearcut	5,200	200	5,400	1,210	150	1,360
Total all conditions	534,300	154,400	688,700	120,150	48,630	168,780

[1/] See glossary for detailed description of material included.

The volume of increment is expressed in standard cords in table 16. This material is the same as that shown in cubic feet in table 15, except that bark is included.

Table 16. - Net increment, in cords, of all sound trees in the various forest conditions, 1937

Forest condition	Pine	Hardwood	Total
		Cords[1]	
Sawlog size:			
Old growth	99,000	227,900	326,900
Second growth	1,061,200	378,300	1,439,500
Under sawlog size:			
Second growth	552,900	137,400	690,300
Reproduction and clear-cut	17,500	2,200	19,700
Total all conditions	1,730,600	745,800	2,476,400

1/See glossary for detailed description of material included.

Increment per acre

The estimate of the average annual increment per acre (table 17) includes the calculated full years growth of the trees harvested during 1937. The values have little direct application to any individual forest property, but they do illustrate the variations in increment between forest conditions, and provide a means of comparing local forest productivity with that of other areas. For instance, the forests of this unit, with an average stocking of 2,210 board feet per acre, are producing an average of 128 board feet per acre compared to 149 board feet in the adjacent coastal plain of South Carolina where the average stocking is 3,300 board feet. The weighted average annual increment per acre does not, however, accurately reflect the increment possibilities of the oncoming second-growth stands. A better measure is the 261 board feet or .78 cords of increment per acre accruing in the second-growth uncut stands. These values can be increased materially as more forest owners accept and practice the principles of forest management.

Table 17. - Average increment per acre by forest conditions, 1937

Forest condition	Saw-timber material			All sound trees	
	Pine	Hardwood	Total	Including bark	Excluding bark
	Board feet			Cords	Cubic feet
Sawlog size:					
Old growth:					
Uncut	57	130	187	.46	32.0
Partly cut	61	78	139	.46	32.0
Second growth:					
Uncut	219	42	261	.78	53.8
Partly cut	146	31	177	.58	39.7
Under sawlog size:					
Second growth	49	5	54	.34	22.8
Reproduction and clear-cut	8	Negl.	8	.03	2.1
Weighted averages	99	29	128	.46	31.2

THE PRIMARY FOREST INDUSTRIES

Primary forest industries are those that obtain their raw material direct from the forest. Important products of these industries in this unit are lumber, fuelwood, poles and piles, crossties, veneer, and pulpwood.

The Lumber Industry

As early as 1750 Wilmington exported longleaf pine lumber to the West Indies and England. The first steam sawmill established at Wilmington was erected in 1818. Lumber production remained at a fairly constant level from 1820 to about 1880, at which time it increased sharply. By 1890 the supply of longleaf pine was rapidly becoming exhausted and loblolly pine, known to the trade as North Carolina pine, assumed a dominant place in the lumber industry. In 1893 there was nearly twice as much lumber cut from loblolly pine as from longleaf pine.1/ At present fully three-fourths of the pine lumber cut in this unit is loblolly.

The present lumber industry is dominated by small portable sawmills (fig. 6), operating chiefly in second-growth timber. Of the 464 mills operating in 1937, only 11 had a sawing capacity of more than 20,000 board feet per day (table 18). Including sawn crossties the total production was 342 million board feet, of which 84 percent was pine, 13 percent mixed hardwoods, and 3 percent cypress (classed with hardwood in table 18). About 75 percent of the pine saw timber and 50 percent of the hardwood were cut from stands of second-growth timber. Hardwood cut by the smaller mills was about 80 percent second growth, while that cut by mills with a capacity of more than 20,000 board feet per day was only 30 percent second growth. Seven million board feet of sawlogs were brought into the unit from the Piedmont and the Coastal Plain counties to the north, but this importation was exceeded by the 33 million board feet of sawlogs shipped from this unit to these outside areas. Sawlogs imported from other states were of negligible amount.

Each size-class of sawmill has certain characteristic features that are summarized in table 18. The data, obtained by interviewing several hundred sawmill operators, reflects only the average situation, which may not apply to specific sawmills. The smaller mills move frequently, averaging a change in location about 4 times a year; one mill moved 19 times in 12 months. Average woods and mill employment in the largest size-class is influenced upward by the presence of 2 mills cutting over 40,000 board feet per day.

It is significant that only 4 sawmill operators reported that they were cutting timber from their own land. This may mean that the lumber industry, having little immediate interest in the future productivity of the forest land being cut-over, will leave large areas in poor condition for future growth. On the other hand, divorcing lumber manufacture from timber growing enables the landowner to concentrate on growing timber at

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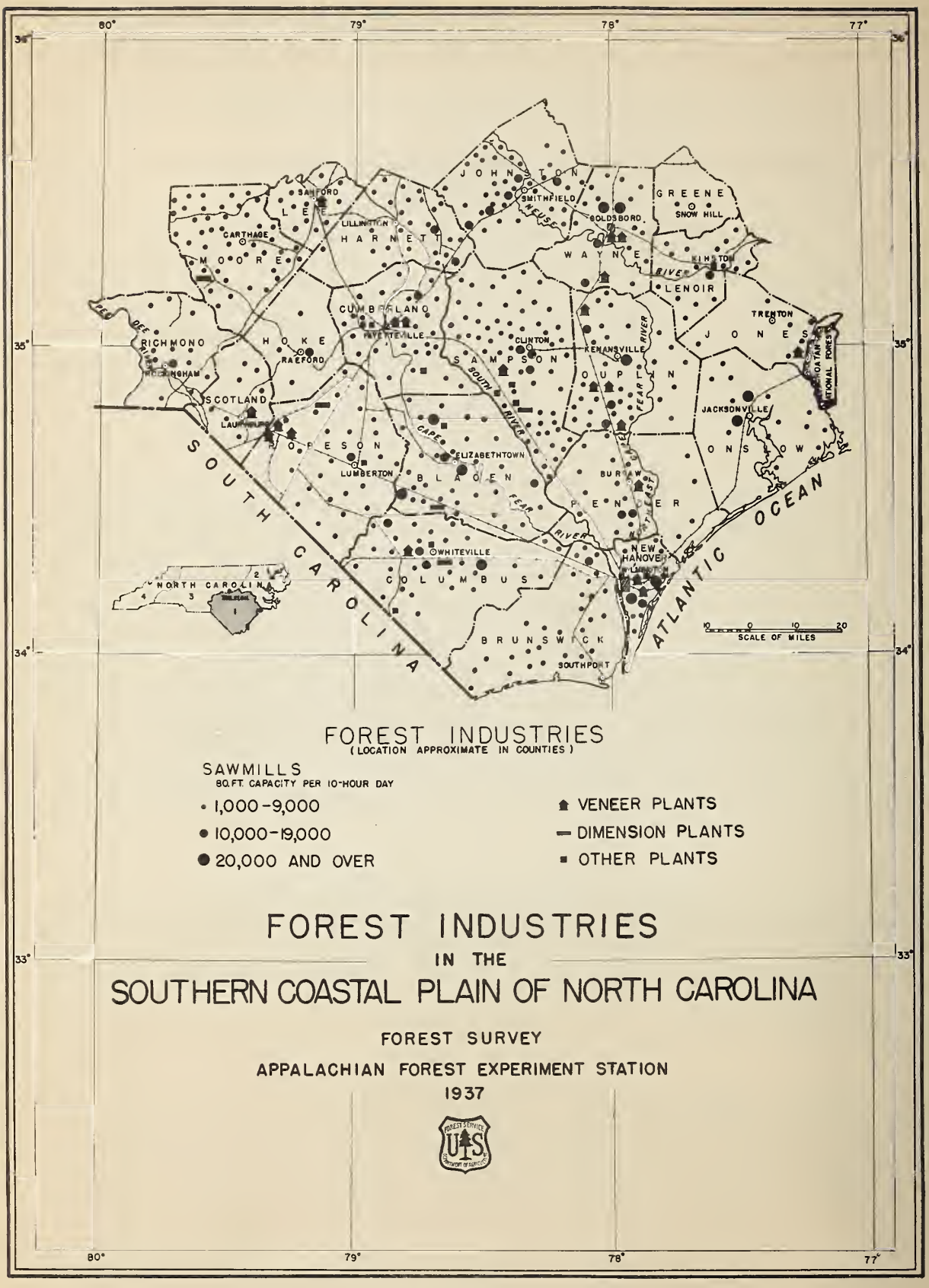
1/Ashe, W. W.; The Forests, Forest Lands, and Forest Products of Eastern North Carolina. Bul. 5, North Carolina Geological Survey, 1894.



FOREST INDUSTRIES
(LOCATION APPROXIMATE IN COUNTIES)

SAWMILLS
BD.FT. CAPACITY PER 10-HOUR DAY

- • 1,000-9,000
- ● 10,000-19,000
- ● 20,000 AND OVER

- ▲ VENEER PLANTS
- — DIMENSION PLANTS
- ■ OTHER PLANTS

FOREST INDUSTRIES
IN THE
SOUTHERN COASTAL PLAIN OF NORTH CAROLINA

FOREST SURVEY

APPALACHIAN FOREST EXPERIMENT STATION

1937

Figure 6

a profit without being burdened by the financial complexities of operating a profitable sawmill. Having smaller overhead costs the timber grower is in a better position to hold his timber for sustained yield, and to sell it when market conditions are most favorable.

Table 18. - Descriptive summary of lumber production in sawmills of various size-classes, 1937

Item	Capacity in thousand board feet per 10-hour day			All mills
	1 - 9	10 - 19	20 and over	
Number of sawmills	424	29	11	464
Avg. 1937 production per mill (M bd.ft.)	490	2,250	6,045	736
Total production of pine (M bd.ft.)	194,000	51,300	41,300	286,600
Total production of hardwood (M bd.ft.)	15,800	14,000	25,200	55,000
Total production all species (M bd.ft.)	209,800	65,300	66,500	341,600
Avg. number of days worked per mill	210	250	235	213
Avg. number of men per sawmill operation	7	23	95	10
Avg. number of men per woods operation	6	11	55	7
Percent of mills using:				
Circular saws	100	93	30	98
Band saws	--	7	70	2
Resaws	--	25	70	3
Edgers	60	100	100	63
Planers	5	79	70	11
Dry kilns	--	67	70	6

Other Forest Industries

The furniture industry of North Carolina has created a local market for furniture veneers. Ten plants in this unit made furniture veneer and plywood in 1937 (table 19). They used about 36 million board feet of high-quality material, mostly red and black gum, and yellow poplar. Eighty percent of the volume was cut from old-growth stands and the bolts used averaged about 18 inches in diameter. Practically all of the plants bought their wood delivered at the mill yard, but one company responsible for about half the production purchased stumpage and logged it with their own woods crew. The product is veneer or 3 and 5-ply panels, usually measured in "panel feet" i.e. square-foot surface measure. About 1,200 men were employed at the 10 plants in 1937, and approximately 165 million panel feet of veneer were produced.

Marketing the berries and truck crops raised throughout the unit requires a great number of crates and baskets. Over 17 million board feet of material were used by the 10 local plants making single-ply crate

and basket veneers in 1937. Gum, pine, and yellow poplar are the chief species used. All of the pine and about half of the hardwood were cut from second-growth stands. About two-thirds of the wood was bought delivered at the plant, the rest was purchased as stumpage. The plants normally employ about 500 men but during the vegetable shipping season additional workers are engaged to fabricate baskets and crates.

Five plants were engaged in the production of hardwood blanks for the furniture trade. They used nearly 8 million board feet of hardwood, practically all black and tupelo gum. About 70 percent of it was taken from second-growth stands. One plant logs its own timber, and the rest buy logs delivered at the mill. About 125 men were employed in the 5 plants operating an average of 300 days each in 1937.

The remaining primary forest industrial plants include 8 shingle mills, 1 box factory, and 2 turpentine stills. The shingle mills are small portable affairs, employing an average of about 5 men. Their output of white cedar, cypress, and pine shingles is used locally. The box factory, using pine and black and tupelo gum, is relatively stationary. About 3 million board feet of timber were cut for the shingle mills and box factory. The 2 turpentine stills were located in Sampson and New Hanover Counties, respectively. They produced about 785 units of naval stores in the 1937-38 season. At present there are no pulp mills operating or under construction in this unit, but a pulp company has purchased a plant location and about 135,000 acres of timberland near Acme in Columbus County. A small quantity of pine pulpwood was shipped outside the unit to mills of the West Virginia Pulp and Paper Company.

A large volume of wood is removed from the forest each year in the form of cross ties, poles and piles, fuelwood, and fenceposts. Of the 270,000 hewn ties cut in 1937, 25 percent were pine, 24 percent were cypress, and 51 percent were hardwood, chiefly red and white oak. Common-carrier railroads purchased 73 percent of the ties, 15 percent were used directly by logging railroads, and 12 percent were purchased by wood-preserving plants. Practically all of the poles and piles were pine, having an average length of 35 feet. Treating plants purchased 99 percent of the production, railroads bought the remainder for local use. Rapid progress in rural electrification has created a local demand for 35-foot class 7 pine poles.

More wood was used for fuel than for lumber in 1937. Over 1.4 million cords of fuelwood were consumed; about 70 percent for heating homes, schools, and small commercial establishments and about 30 percent for curing tobacco. Approximately 604,000 cords were derived from cull trees, sawmill waste, and top-wood of hardwood trees. The removal of cull trees improves the quality and growing condition of the remaining stand, and in view of the large amount of cull timber available (table 10) it would be good forestry to cut an even larger part of the fuelwood requirement from these low-quality trees and save the present or prospective sawtimber for a more profitable use.

It is estimated that 51,000 cords of wood were used on farms for such items as fence posts and tobacco barns. Fencing is infrequent in this unit and most of the posts are made of material nearest at hand, ranging all the way from small pine or gum saplings to good quality split oak or pine, and round cedar posts. A majority of the new tobacco barns are made of lumber but in the more isolated districts new barns of squared logs are often seen.

Employment

Forest labor is utilized both in the production of forest products for sale and in obtaining wood products for home use. Employment in the lumber, veneer, crosstie, pole, and miscellaneous industries, which provides a cash income to the employee, amounted to only 45 percent of the 3.2 million man-days of forest employment (table 19). Workers in the various plants and sawmills were given fairly continuous employment in 1937; as even the smaller sawmills averaged more than 200 days operating time. Many individuals worked full-time getting out sawlogs, veneer blocks, poles, or crossties, but much of this material was produced by farmers between crop seasons. At least 10,000 individuals were commercially employed in the primary forest industries and in view of the part-time forest activity of many farmers it is probable that 15,000 or more received a share of their income from forest work. At 25¢ per hour the total income from forest industrial employment would be 3.6 million dollars.

Table 19. - Production and employment in the primary forest industries, 1937

Kind of plant or commodity	Number of plants	Cut in woods	Produced or used by plants	Employment provided		
				In woods	In plants	Total
		M bd.ft.			Thousand man-days	
Sawmills	464	367,400	341,600	445	561	1,006
Furniture veneer	10	33,700	36,500	63	142	205
Package veneer	10	17,000	17,000	32	66	98
Furniture dimension	5	7,700	7,700	11	27	38
Misc. manufactures[1]	9	4,200[2]	3,000	12	8	20
		M pieces				
Crossties (hewn)	--	270	--	38	--	38
Poles and piles	--	149	--	33	--	33
		Units				
Naval stores	2	--	785	14	1	15
		M cords				
Fuelwood	--	1,433	--	1,720	--	1,720
Misc. farm use	--	51	--	56	--	56
Total	500	--	--	2,424	805	3,229

1/ Includes 8 shingle mills and one box factory.
2/ Includes pulpwood cut from saw-timber trees.

Fifty-five percent of the forest employment was utilized in the production of fuelwood and material for farm maintenance. Comparatively little of the fuelwood was sold commercially to obtain a direct cash income. At $3.00 a cord, however, the fuelwood has a value of 4.3 million dollars, which, after deductions for stumpage and transportation, represents the indirect wage retained by farmers, as they use most of the wood. With 73,000 farm operators depending largely upon home-cut wood for fuel, it is obvious that cutting firewood is a task engaged in by many thousands.

Commodity Drain

The commodity drain from the sound-tree growing stock (table 20) includes both the utilized material and the sound usable material left in felled trees. The drain on the saw-timber portion of the trees, including both the utilized and wasted portions, is expressed in board feet, while the volumes given in cubic feet include drain on saw-timber material, upper stems of sawlog-size pines, and small trees ranging from 5.0 inches d.b.h. up to sawlog size.

About three-fourths of the total saw-timber drain was cut from the pines and one-fourth from the hardwoods. Only 20 percent of the pine was cut from old-growth stands of timber in contrast to nearly 60 percent of the hardwood. Lumber production caused 62 percent of the drain and fuelwood an additional 22 percent. Field observations indicate that there is very little waste in the cutting of sawlogs, particularly in the pine species. Frequently the rough top logs are used for fuelwood, and in some cases the larger limbs are utilized. Although not much wood is left on the ground unused there is need for more discrimination in the use of the various classes of material. Burning 100 million feet of pine saw timber for firewood in one year is scarcely justified in a region where stumpage brings $3.00 to $6.00 per thousand board feet. More of the fuelwood should be cut from the poorer quality second-growth hardwood that threatens to replace the pine on many areas.

Fuelwood constitutes most of the drain on trees below sawlog size. As a consequence the proportion of the cubic-foot drain caused by lumbering drops to 48 percent while the fuelwood drain increases to 38 percent of the total. If part of the fuelwood were not taken from cull trees and sawmill waste the fuelwood drain would exceed the drain caused by lumbering.

Table 20. - Commodity drain from the sound-tree growing stock, 1937

Commodity	Saw-timber material			All sound trees[1/]		
	Pine	Hardwood	Total	Pine	Hardwood	Total
	Thousand board feet			Thousand cubic feet		
Lumber	309,100	58,300	367,400	60,730	9,740	70,470
Veneer	3,300	52,000	55,300	650	8,630	9,280
Crossties	3,700	12,400	16,100	720	2,150	2,870
Poles and piles	9,700	100	9,800	1,910	20	1,930
Misc. manufactures	2,300	10,800	13,100	560	1,800	2,360
Fuelwood	102,300	26,000	128,300	36,210	19,390	55,600
Misc. farm use	3,300	2,200	5,500	1,780	1,160	2,940
Total	433.700	161,800	595,500	102,560	42,890	145,450

1/Total drain from growing stock expressed in cords of wood with bark: pine, 1,439,100; hardwood, 638,900.

COMPARISON OF INCREMENT WITH COMMODITY DRAIN

In this section the interrelations of growth, mortality, net increment and commodity drain are analyzed to determine the status of the forest stand and the possibility of forest industrial expansion.

Comparison in Board Feet

During 1937 the forests of this unit increased in saw-timber volume by 93 million board feet, for, although the commodity drain was large, the net increment was even larger (table 21). This favorable situation is due, in part, to the rapid growth of the second-growth pine stands, particularly those just approaching sawlog size. In the old-growth pine timber the increment is approximately half the drain, in the second-growth sawlog-size stands the increment exceeds the drain by more than enough to make up the deficit in the old-growth condition, while in the under-sawlog-size condition the saw-timber increment is nearly 10 times the drain.

The pine saw-timber drain is chiefly for lumber and a high proportion of it is cut from the larger trees. Although the portable mills often cut too heavily, much of their cutting is in relatively even-aged old-field stands. As timber is not particularly scarce cutting is most frequent in the older, merchantable stands, and decks of very small logs cut from young timber are seldom encountered. In view of the large area of young pines that is rapidly reaching saw-timber size, the surplus of increment in 1937, and the reported reduction in lumber cut in 1938, it appears that the pine growing stock can continue to meet the demands made upon it, on a sustained yield basis, provided there is no radical increase in the forest industries. Furthermore, if the drain does not greatly increase in the next 10 to 15 years, the constantly augmented growing stock will then produce an annual increment sufficient to justify an expansion of the wood-using industries.

The relation of increment and drain in the hardwood species, including cypress, cannot be judged correctly by the 7 million board feet reduction in growing stock in 1937. The deficit was entirely in cypress, as the cut of this species was more than twice the increment. It is, however, good forestry practice to cut the mature old-growth cypress and as second growth is limited in quantity and low in growth rate there is little justification for expecting to have a balanced cypress budget.

Increment of the remaining hardwoods was 4 million board feet more than the drain, a surplus too small to be significant. Of far greater importance is the fact that drain is confined to a relatively few species while increment occurred in all species. Also about half of the hardwood was cut from old-growth stands, a drain of high-grade material that was twice the increment accumulating on old-growth trees of similar quality. The result is an overcut of certain species (ash, white oak, swamp red oak, yellow poplar, old-growth red gum) and grades of hardwood, leaving an increasing proportion of the less valuable species (willow oak, water oak, post oak, bay, black gum) and poorer quality trees. The prospect of an increased supply of high-quality hardwood saw timber is not bright and it is probable that the larger sawmills will gradually shift to pine as good hardwood becomes scarce. The smaller mills probably will cut an increasing amount of low-grade hardwood and the veneer plants will turn increasingly to black gum, the most abundant hardwood in the unit. As these changes will be gradual the effect upon the forest industrial organization will probably be slight.

Table 21. - Balance between increment and drain of saw-timber material, 1937

Item	Pine	Hardwood[1/]	Total
	- - - - Thousand board feet - - - -		
Net growing stock, Jan. 1, 1937	8,452,500	3,808,500	12,261,000
Growth, 1937	583,000	182,900	765,900
Mortality, 1937	48,700	28,500	77,200
Net increment, 1937	534,300	154,400	688,700
Commodity drain, 1937	433,700	161,800	595,500
Net change in growing stock, 1937	+100,600	-7,400	+93,200
Net growing stock, Jan. 1, 1938	8,553,100	3,801,100	12,354,200

1/Includes cypress.

Comparison in Cubic Feet

Increment in the sound growing-stock trees 5.0 inches d.b.h. and larger was 23 million cubic feet more than the commodity drain, resulting in nearly a one percent increase in the growing stock in 1937 (table 22). Considering the volume of growing stock, the increment, and the commodity drain, it appears that the cubic volume inside bark of sound pine is increasing nearly twice as fast as is the sound volume of hardwood. The influx of many cull hardwoods on cutover pine land is, however, a silvicultural problem that must be solved if pine is to maintain its present position in the support of industry.

Table 22. - Balance between increment and drain of all sound material, 1937

Item	Pine	Hardwood	Total
	- - - Thousand cubic feet (i.b.) - - -		
Net growing stock, Jan. 1, 1937	2,195,640	1,405,060	3,600,700
Growth, 1937	135,680	59,580	195,260
Mortality, 1937	15,530	10,950	26,480
Net increment, 1937	120,150	48,630	168,780
Commodity drain, 1937	102,560	42,890	145,450
Net change in growing stock, 1937	+17,590	+5,740	+23,330
Net growing stock, Jan. 1, 1938	2,213,230	1,410,800	3,624,030

Comparison in Cords

Figure 7 provides a comparison of interest to the cordwood industries. Increment is not indicated but the figure shows that after commodity and mortality drain were deducted from growth there were about 300,000 cords of pine and 100,000 cords of hardwoods left to increase the growing stock. This is enough surplus to supply at least a medium-sized pulp mill without depleting the growing stock or jeopardizing the continued existence of the present industries. Also, in theory, a pulp-mill would provide a market for thinnings and low-grade top logs that is almost essential for intensive forestry. In particular, a mill is needed to utilize the large volume of second growth and sound cull black and tupelo gum. In order to insure a permanent supply of raw material any pulp mill developed should own and manage enough forest land to supply a major share of their requirements, and follow good cutting practices upon other privately owned land.

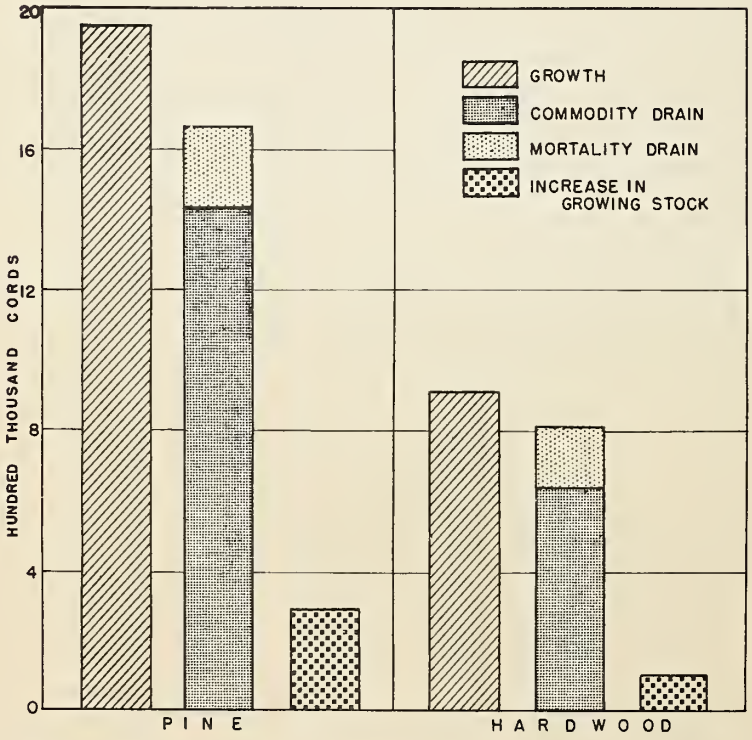


FIGURE 7.- COMPARISON OF GROWTH WITH MORTALITY AND COMMODITY DRAIN, 1937

FOREST PROBLEMS AND ACTION NEEDED

In its present condition the forest is producing enough wood to meet domestic needs and supply the requirements of the wood-using industries. The surplus is small, however, and a material increase in timber use will cause the forest resource to decrease. In view of this unit's accessibility to the markets of the East, its existing industrial organization, and its growing population, it is reasonable to assume that an increasing amount of wood will be cut. An increased cut on a sound basis is desirable for economic and social reasons, but before it can be realized several major forest problems must be solved.

Deficiency of Growing Stock

Since the prerequisite for a larger cut is a greater increment, it will be necessary to increase the volume of growing stock. Under existing conditions the sound-tree growing stock has not completely utilized the growing space and the annual yield of wood is less than the site potentiality. It is estimated that there is an opportunity to increase the volume of growing stock for the entire unit by at least one-half, with an accompanying increase in annual increment. Building up the growing stock will be a slow process, attainable only through the adoption of better forest practices by the individual land owners. These practices call for prevention of forest fires, cutting methods to insure adequate restocking, thinnings in dense young stands, interplanting in forest openings, planting of abandoned fields and clear-cut areas where they will not restock naturally, and restriction of the cut to about three-fourths of the annual increment until the forest approaches full stocking. Their general acceptance depends upon the ability of forestry agencies to: (1) prove that such practices are financially attractive, and (2) inform the thousands of landowners of the proper forest management technique.

Methods of Cutting

The pine species are the basis for most of the forest industry in the unit. Their wide distribution, adaptability to manufacture, and universal use make them an almost essential component of the forest stand. Nearly 70 percent of the present saw-timber volume and 60 percent of the cordwood volume in sound trees is pine. The emphasis placed upon its utilization and the increasing effectiveness of fire protection have, however, created a problem with far-reaching potentialities. Many of the stands of second-growth pine have a dense understory of small hardwood trees and shrubs. When the pines are removed these hardwoods occupy the land, and may effectively prevent the establishment of pine for many years. Although there is no lack of pine at the present time some foresters and timberland owners believe that hardwoods will gradually replace the pines unless changes in cutting methods are adopted.

More research is needed to determine the best methods of handling the timberlands, particularly loblolly pine, in the Coastal Plain of North Carolina. Conditions here are not entirely similar to conditions in the Deep South where selective cutting has been found a satisfactory way of harvesting mature stands of loblolly pine. In the Coastal Plain of North Carolina many young pine stands are thinned for pulpwood, poles, or small saw timber, a practice that is often referred to as selective cutting. Such thinning is a desirable intermediate step in the management cycle of the stand. It is entirely practical and is applicable to large areas in the pine types. The selective cutting method in which more research is needed deals, however, with the process of selectively harvesting mature stands of saw timber in a manner that will insure a new stand of second growth. The limited amount of experimental selective cutting so far conducted in the Coastal Plain has not yielded very favorable results. To date, clear-cutting with seed trees has most satisfactorily restocked the ground to loblolly pine. It must be emphasized, however, that studies of both clear and selective cutting have been inconclusive and these, as well as other methods, need much more investigation before the problem can be considered solved.

Utilization of Hardwoods

Certain of the better-quality hardwoods are being utilized for lumber and veneer, but there is a great quantity of black and tupelo gum that is less suitable for such use. In these species there are nearly 3 million cords in cull trees alone, and the total sound volume of 12 million cords is 18 percent of the cordwood volume in the unit. Such a large part of the resource must not be neglected in any program of increased forest use, but the ways and means of profitable utilization present a problem. The existing mills can use only a small part of the available volume so it will be necessary to interest new industries. As a suggestion, Wilmington is a favorable location for a hardwood pulpmill, from the standpoint of wood supply, transportation of wood to the plant, and seaport facilities.

The Portable Sawmills

It has become almost a custom to blame forest devastation upon the portable sawmill operator. Unfortunately, much of this criticism is deserved and in certain parts of the South the portable mills have cleared the land of all worth-while saw timber. In this unit, as elsewhere, they often strip the land and leave it in poor condition for future growth. With no proprietary interest in forest land they are uninterested in cutting methods that will assure a new crop of timber. Engaged largely in intrastate business, they supply the local market with cheap lumber produced without the restrictions of the Wage and Hour Law, and thus destroy the local markets of the larger, more stable operations whose production costs are higher because of this law. Furthermore, the portable mills possess a flexibility that enables them to shut down when the market is bad, and to flood the market with lumber when times are good, thus reducing the average annual income of the more permanent operations.

What to do about the portable sawmills? For the present they serve a useful purpose in providing a market for the timber held in small tracts by thousands of owners. They also give employment to several thousand workers, and distribute this employment throughout every county of the unit. In the long run, however, a more stable form of sawmill organization should be developed. This is a difficult task. Some improvement may be obtained by demonstrating the advantages of conservative cutting to the small mill operators. Essentially, however, it is a matter of convincing the forest land owners that sustained-yield forestry will pay and that lump-sum sales to portable mills are against their best interests. Groups of individual land owners managing their woodlands to produce an annual crop of timber can usually interest a larger mill in providing a market. The community and region will benefit through permanent industries, more complete processing, more employment at higher wages, a definite wood market, and a more stabilized basis for forest management.

Fire Control

The risk of fire is a serious obstacle to the practice of forestry and the destruction caused by forest fires is an important source of loss. Both of these factors are operative in preventing greater yields of forest crops in this unit. Increasingly effective protection from fires is being obtained through the efforts of the North Carolina Division of Forestry and the United States Forest Service. As of June 30, 1938, eight private protective associations and all the counties except New Hanover were cooperating in the fire control program. The technique of fire control is undergoing constant improvement but inadequate financing precludes entirely satisfactory protection. In the fiscal year 1937-38 the direct state appropriation for fire control in the state was only $38,000 while the estimated damage from forest fires on non-federal lands in 1938 was $470,000. The framework for intensive fire control already exists over this unit, but the available funds for each protected acre approximated only 1.2 cents in 1937, whereas adequate and efficient fire protection costs about 4.6[1/] cents per acre per year. Increased appropriations for fire control are badly needed, and the responsibility for providing them rests heavily upon the State and Federal Governments, as well as upon the private owner.

Taxation

The development of full forest productivity is retarded by the method of taxing forest property. In brief, the general property tax, as applied in this unit, discriminates against forest owners at the two crucial points in the development of the stand; i.e., when the newly cut-over land has no immediate prospect of revenue and when the young stand is approaching saw-timber size. Over-assessment in the first case causes some land-owners to give up the idea of growing timber as a profitable business and reassessment at a sharply increased value in the second case may cause owners to dispose of their timber prematurely.

1/North Carolina Department of Conservation and Development, 7th Bien. Rept., June 30, 1938.

Defective administration of the general property tax causes wide variation in the assessment of similar land classes, and leads to confusion and discouragement among land owners. For instance, in Cumberland County in 1937 the average assessed value of cut-over land in one township was $2.97 while cut-over land in another township was assessed at $10.10. Irregularities such as this coupled with unpredictable assessment policies are distinctly unfavorable to sustained-yield management for forest properties.

Full discussion of the tax problem is outside the scope of this report. Nelson[2/] after making a study of taxation of forest property in North Carolina, suggests that improvement of assessment administration holds promise of greatest and most immediate benefit; secured through the employment of expert full-time assessors, acting under state supervision.

2/Nelson, R. W., Taxation of Forest Property in North Carolina, Forest Taxation Inquiry, U. S. Forest Service.

SUMMARY

Since early colonial days the forest resource has been an important factor in the economic life of this region. More than 2 centuries of unrestricted use have caused many changes in the forest growing stock but the present-day forest is nevertheless an important source of raw material for domestic and industrial use. Agriculture is now the dominant industry, but forests occupy two-thirds of all the land.

The forest is distributed throughout the unit but there is a higher proportion of wooded land in the Tidewater counties. Pine types occupy three-fourths of the forest area, with loblolly pine the most abundant species. Nearly ninety percent of the forest is second growth, with most of the stands less than 75 years old. About half of the stand is saw-timber size, 47 percent is under sawlog size, and 2 percent is clear-cut. The total saw-timber volume is 12.3 billion board feet; two-thirds pine and one-third hardwoods. There are 66.7 million standard cords of wood with bark or 4.5 billion cubic feet of wood only. Increment amounted to 689 million board feet, 2.5 million cords, or 169 million cubic feet.

At least 464 sawmills operated in 1937, 424 of which had a capacity of less than 10,000 board feet per day. Veneer for furniture and package stock was produced by 20 plants and ranked after lumber in commercial importance. About 1.4 million cords of fuelwood were used in 1937; chiefly on farms. These, and other forest activities, provided 3.2 million man-days of employment which returned a cash income to at least 10,000 workers. The commodity drain amounted to about 596 million board feet of saw timber or 145 million cubic feet of all sound material. Increment was greater than drain, so that the forest growing stock increased by 93 million board feet, or 23 million cubic feet.

The relation of increment to forest depletion is reasonably satisfactory. There is a large and active forest industry and, broadly speaking, the timber resource is increasing faster than it is being used. Nearly half of the forest is young second growth that will increase the supply of saw timber at a very rapid rate during the next decade. This development of small trees into saw-timber sizes will, however, further reduce the quality of the board-foot volume, making it necessary to import high-quality timber requirements from other regions. Unless radical change occurs in the agricultural situation more than half of the land will continue to be used for timber production. Full use of this forest land will require education of land owners, research in timber management, promotion of specific industries, more intensive fire control, and revision of the tax structure. As the effects of these measures become apparent in greater yields of wood a gradual expansion of forest industry will be justified.

GLOSSARY

General

Forest survey unit. -- The term "forest survey unit" denotes an area of 4 to 10 million acres in which topographic, forest, economic, and industrial conditions are reasonably homogeneous.

Land-use Classes

Productive forest area. -- Forest land having qualities essential for the growth of commercial timber.

Non-productive forest area. -- Forest land lacking qualities essential for the growth of commercial timber.

Cropland, old and new. -- Land used for production of farm or orchard crops or evidently so used during the last 5 years. This includes new cropland, i.e., land converted from forest to cropland within 5 years prior to survey.

Pasture. -- Cleared or open land under fence used primarily for grazing.

Abandoned cropland. -- Land once cultivated but showing distinct evidence of having been abandoned for agricultural crop production. Restocking to timber has not yet occurred.

Other non-forest. -- Areas included within the corporate limits and suburban or industrial sections of cities and communities; power, rail, and highway rights-of-way; marsh; and non-meandered waterways.

Forest Types

Loblolly pine-hardwoods. -- Stands in which pines make up 25 percent or more of the dominant and codominant stems with loblolly pine predominating.

Pond pine-hardwoods. -- Stands in which pines make up 25 percent or more of the dominant and codominant stems with pond pine predominating.

Longleaf pine. -- Stands in which pines made up 25 percent or more of the dominant and codominant stems with longleaf pine predominating.

Upland hardwoods. -- Stands in which mixed oaks and other hardwoods make up 75 percent or more of the dominant and codominant stems, usually found on the rolling upland sites.

Bottomland hardwoods. -- Stands in which hardwoods make up 75 percent or more of the dominant and codominant stems, usually found in river bottoms.

Diameters

D.b.h. (diameter at breast height). -- Diameter, outside of bark, measured at $4\frac{1}{2}$ feet from the ground.

Diameter class. -- All trees were recorded in 2-inch diameter classes, including diameters 1.0 inch below and 0.9 above the stated midpoint, e.g., trees 7.0 to 8.9 inches d.b.h. are placed in the 8-inch class.

Tree Classification

Sound sawlog-size tree. -- A pine, cypress, or cedar tree at least 9.0 inches d.b.h., or a hardwood tree at least 13.0 inches d.b.h., with not less than one sound butt log 12 feet long, or with 50 percent of the gross volume of the tree in sound sawtimber.

Sound under sawlog-size tree. -- Any tree over 1.0 inch d.b.h. and less than sawlog-size, at least 75 percent sound with a reasonably straight stem.

Cull tree. -- Any tree that fails to qualify as a sound sawlog or under-sawlog-size tree because of form, limbiness, rot, or other defect.

Pole or pile tree. -- A pine tree that will produce a pole or pile conforming to pole specifications of the American Standards Association.

Forest Conditions

Sawlog Size

Old growth, uncut. -- Stands composed of trees having the characteristics of the original mature timber of the region and containing at least 1,000 board feet per acre of merchantable species in hardwood types, and 600 board feet per acre in pine types, with less than 10 percent of the volume cut.

Old growth, partly cut. -- Old-growth stands from which 10 percent or more of the volume has been cut, leaving a minimum of 1,000 board feet per acre in the hardwood types, or 600 board feet per acre in the pine types.

Second growth, uncut. -- Stands of second growth having at least 600 board feet per acre in trees of sawlog-size, and with less than 10 percent of the sawlog-size trees removed.

Second growth, partly cut. -- Stands of second growth from which 10 percent or more of the sawlog-size trees have been removed but with the remaining stand containing 600 or more board feet per acre.

Under Sawlog Size

Second growth. -- Young second-growth stands in which the volume of timber in trees of sawlog size is less than 600 board feet per acre and the remainder of the trees are below sawlog size.

Reproduction. -- Stands too young to classify as second growth, having at least 80 well-distributed seedlings per acre.

Clear-cut. -- Cut-over areas having insufficient young growth to qualify either as second growth or reproduction.

Volume Estimates

Board-foot volume. -- Only the saw-timber portion of sawlog-size trees are included in this estimate. Top diameters vary with the limits of usable material. Deductions are made for woods cull and for loss in sawing at the mill.

Cordwood volume. -- This volume (including bark) is derived from the following sources:

1. The sawlog portion of sawlog-size trees.

2. The portion of saw-timber trees not usable as sawlogs but acceptable as cordwood. This includes the upper stems of pine and cedar and, unless otherwise noted, the upper stems and limbs of hardwoods and cypress. The minimum diameter limit is 4.0 inches outside bark.

3. The full stem of sound under-sawlog-size trees, at least 5.0 inches d.b.h., to a variable top diameter not less than 4.0 inches outside bark.

4. The estimated sound material in cull trees.

Deductions for cull include only the volume in defects which cause the material to be unsuited for cordwood. Sweep and slight crook are not regarded as defects.

Standard cord. -- A stacked pile of round or split wood bolts measuring 4' x 4' x 8' and estimated to contain 90 cubic feet of wood and bark in the pine, cedar, and cypress species, and 80 cubic feet of wood and bark in the hardwood species.

Cubic-foot volume. -- This volume is derived from the same sources as the cordwood volume except that bark is not included.

Increment

Growing stock. -- The sum of the volumes of all sound trees 5.0 inches d.b.h. and larger; dead and cull trees and tops of hardwood and cypress not included.

Board foot increment. -- Includes the net growth on the saw-timber portion of sawlog-size trees, plus the volume in sound trees reaching sawlog-size.

Cordwood increment. -- Includes the net growth on the sound stemwood of pines and cedar 5.0 inches d.b.h. and over, on under sawlog-size hardwoods and cypress, and on the sawlog portion of sawlog-size hardwoods and cypress.

Cubic foot increment. -- Omits bark volumes, otherwise material is identical to cordwood.

Mortality

Mortality. -- The volume lost from the growing stock of the forest through the death of individual trees. Natural causes of mortality include tree competition, old age, disease, insects, drought, and wind. Fire is the major man-caused source of mortality.